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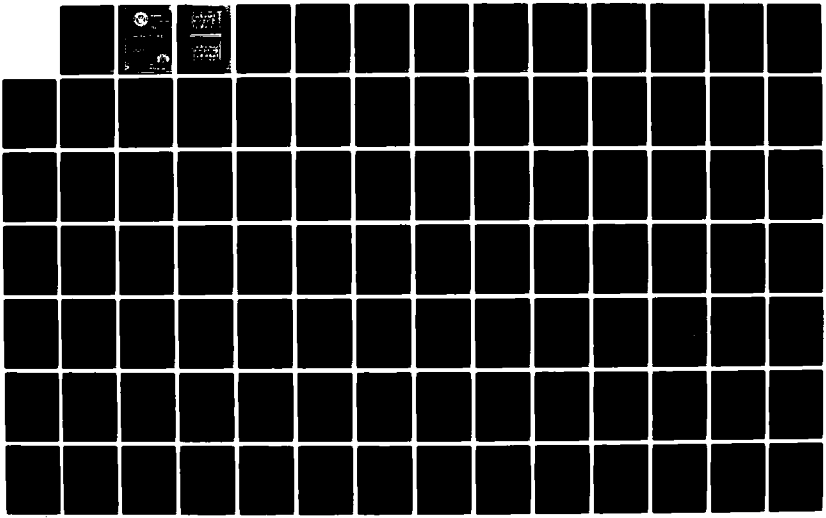

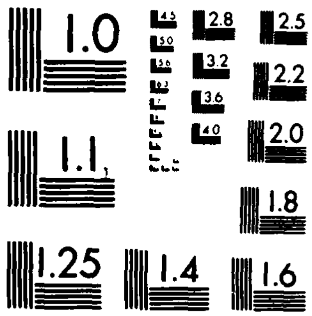

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selected for investigation because it was expected to severely exercise CS and CSS elements.

The conclusions ~~and recommendations of the report~~ indicate that there is a feasible set of tactical, CS, and CSS concepts suitable for operation of MCATFs on varied depth of penetration missions in the long-range time frame. The CS and CSS concepts described require doctrinal, organizational, and equipment changes and improvements that are justified by the tactical flexibility and capability that they allow MCATFs to display in executing their missions.

Part III ~~of the main body of the report~~ presents an overview of the POL (Class III and IIIA) requirements and distribution concepts, the details of which are contained in Annex B of the report. The most significant aspect of this analysis is the validity of using SIXCON fuel modules as a primary container system for helicopter lift of fuel and subsequent distribution within the MCATF. Also of interest is the finding that AAFS, TAFS, and HERS type systems remain essential to overall capabilities.

CONCEPTS FOR COMBAT SUPPORT AND SERVICE SUPPORT TO A MECHANIZED COMBINED ARMS TASK FORCE IN THE MID- AND LONG-RANGE TIME FRAMES

VOLUME I

BASIC REPORT

APRIL 1983

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VOLUME I

BASIC REPORT

Table of Contents

Table of Contents (Cont'd)

Table of Contents (Cont'd)

LIST OF FIGURES

Table of Contents (Cont'd)

LIST OF FIGURES (Continued)

LIST OF TABLES

Table of Contents (Cont'd)

LIST OF TABLES (Cont'd)

LIST OF ANNEXES

EXECUTIVE SUMMARY

This report presents the results of a study conducted by Potomac General Research Group (PGRG) for the Naval Civil Engineering Laboratory of the Department of the Navy. The study investigated the expected operations and employment of a Marine Corps Mechanized Combined Arms Task Force (MCATF), both in the mid-range (1983-1992) and in the long-range (1993-2000), and constructed concepts for the conduct of combat support (CS) and combat service support (CSS) compatible with MCATF characteristics. The MCATF was selected for investigation because it was expected to severely exercise CS and CSS elements. The study was intended to be highly conceptual and exploratory in nature with emphasis on concepts to support the most flexible employment of MCATFs rather than on generation of optimal concepts based on hardware, manpower and other resource constraints.

The specific objectives of the study were to:

- Identify concepts in the mid- and long-range time [illegible]es for combat support and combat service support in the [illegible]ibed environments.
- Identify the effectiveness and efficiency of the concepts in support of a MCATF.
- Identify deficiencies in current capabilities to meet the subsequently developed concepts.
- Identify a methodology for the development necessary to advance the current capability to the level required.

The approach selected was one which permitted PGRG latitude in identifying CS and CSS functions and penetration/supply concept permutations of sufficient importance to be analyzed, so as to conserve the limited study resources for high payoff areas. Although the interest of the study was in the CS and CSS functions, considerable effort was required to define MCATF tactical concepts and to generate support requirements compatible with those concepts.

LONG RANGE CONCEPTS

Tactical Concepts

Contemporary tactical concepts and techniques for the MCATF are evolving through phased testing and evaluation at the Marine Corps Air Ground Combat Center (MCAGCC). These concepts and techniques are recorded in evaluation reports and in Operational Handbook (OH) 9-3, Mechanized Combined Arms Task Forces (MCATF). The current edition of the handbook, Revision A, March 1980, was used as a basic reference for this study. Tactical concepts for the long range period were derived from evaluation of contemporary concepts, a series of studies and analyses recently performed by PGRG, PGRG seminars, a general review of the literature, and from principles enunciated in the Marine Corps

Long Range Plan (MLRP). The focus is on a maneuver style of warfare applicable to MCATF tactical operations in both the amphibious and non-amphibious modes. This will be a unique style, evolved by Marines, the fundamentals of which are summarized as follows:

- The MCATF is omnidirectional with maneuver elements separated on the battlefield.
- There is no forward edge of the battle area (FEBA) per se.
- There is no secure rear area immediately "behind" the MCATF nor any secure MSR.
- There is normally no BSA in the amphibious mode.
- Equal or compatible mobility and survivability is required for all systems and equipment on the MCATF battlefield.
- There is a confirmed definitional trend and focus: Mechanized Combined Arms Task Force.

For this study, two basic sizes of MAGTFs were used as representative of major Marine Corps contingency tasking: (1) a force with one regimental MCATF containing four battalion level maneuver elements, and (2) a force containing three regimental MCATFs, representative of Rapid Deployment Joint Task Force (RDJTF) commitments.

The long range CS concepts are presented in the context of combined arms. Concepts are primarily focused on recon-pull tactics based on near-real-time intelligence, engagement at extended ranges, and high mobility of separated maneuver elements. Figure i illustrates a typical array of maneuver elements in a regimental MCATF.

Combat Support Concepts

Reconnaissance and intelligence play a particularly important role in support of MCATF maneuver warfare operations. Both the distances between maneuver elements and the rapidity of movement increase the requirement for area coverage by recon/intel assets. The MCATF must have highly effective, mobile, ground and air recon assets, both organic and either attached or in direct support. Both the MCATF commander and his maneuver element commanders must have near-real-time intelligence.

Artillery support for a MCATF must have the capability to support both the entire organization and its component maneuver elements as they move rapidly over the area of operations separated from each other by distances approaching the maximum range of artillery. High closing speeds of opposing forces increase the requirement for fire missions at or near maximum range beyond the maneuver elements. This requirement is met by attachment of an artillery battery, reinforced as necessary, to each maneuver element. The artillery weapons must be highly ground mobile to accompany the mechanized battalion without slowing it down.

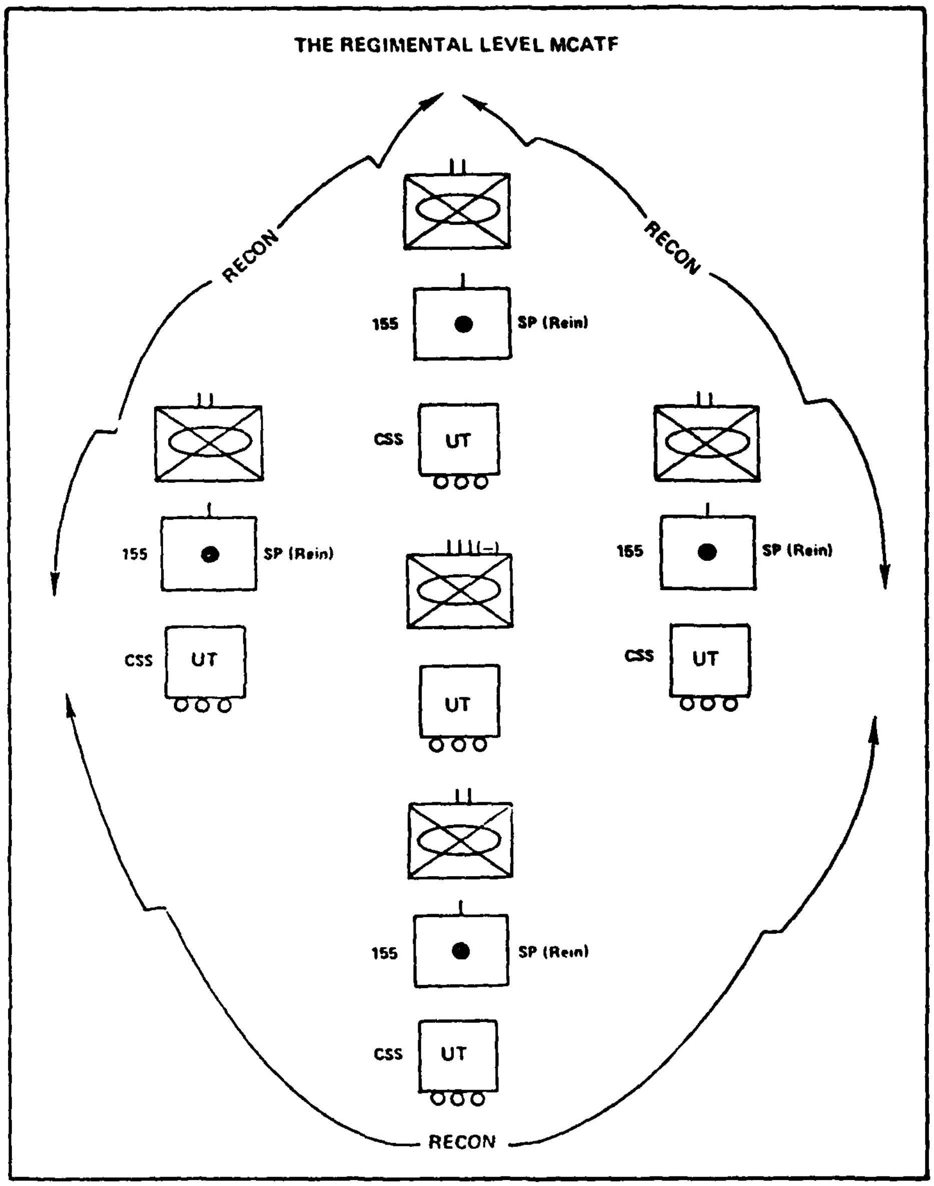


Figure i. Diagram of the Regimental MCATF

Close air support is essential both to reach out beyond artillery range and to provide concentrations of fire support normally provided by general support artillery. Attack helicopters will operate from deck alert or ground loiter near the supported maneuver elements. Fixed-wing V/STOL attack aircraft would also be on deck/strip alert, preferably at least 20 NM from the battle area. Conventional fixed-wing aircraft would be expected to normally close air support and counterair missions over the battle area. Ground-based antiair defense would be limited to mobile air defense systems attached to the MCATF.

Combat engineer support will be provided by a reinforced combat engineer company (mobile) attached or organic to a regimental MCATF. They would have the dual missions of maintaining and enhancing the maneuverability of the force and helping to impede the maneuverability of the enemy. Clearing and maintaining LZs, light obstacle breaching, gap crossing, hasty defense preparation, and hasty minefield emplacement will be extremely important tasks. Preparation or breaching of fortifications, route preparation or maintenance, and horizontal or vertical construction will seldom if ever be required.

Greatly increased intra-command distances pose the principal difficulty in achieving and maintaining tactical communications. Effective support for the MCATF must be built around long-range, high frequency (HF) systems and airborne/satellite relay systems. Even so there is high likelihood of intermittent interruption of communications.

Combat Service Support Concepts

The tactical requirement for high mobility and maneuverability requires that each maneuver element of a MCATF have a highly mobile organic unit train to carry additional supplies. The unit trains must be of modest size so as not to restrict tactical operations. About one day of supply should be carried by the unit trains of a MCATF. This gives the MCATF a limited capability for self-sufficient operations. Where possible, resupply direct to the unit trains by transport helicopter is preferred because helicopters have the speed necessary to overtake and rendezvous with a penetraing MCATF, and they can avoid ground-based threats or obstacles that may intervene. This single-circuit support concept has limited range, approximately 75 NM would be the maximum planning distance (depending on the environment). Figure ii illustrates the single-circuit supply concept from ship direct to maneuver element unit train.

To resupply penetrations beyond the radius of helicopter operations requires that some CSS facility be projected beyond the secure area to provide a helicopter resupply point and a limited packaging transition point, if required. A mobile CSS detachment (MCSSD), if unprotected, would be vulnerable to enemy action, as illustrated in figure iii. To provide security to an MCSSD capable of supporting one or more regimental MCATFs would require the assets of another similar sized MCATF. For MAGTF operations of sufficient size, penetrations of approximately 150 NM could be supported by a centroidal-elliptical concept such as illustrated in figure iv.

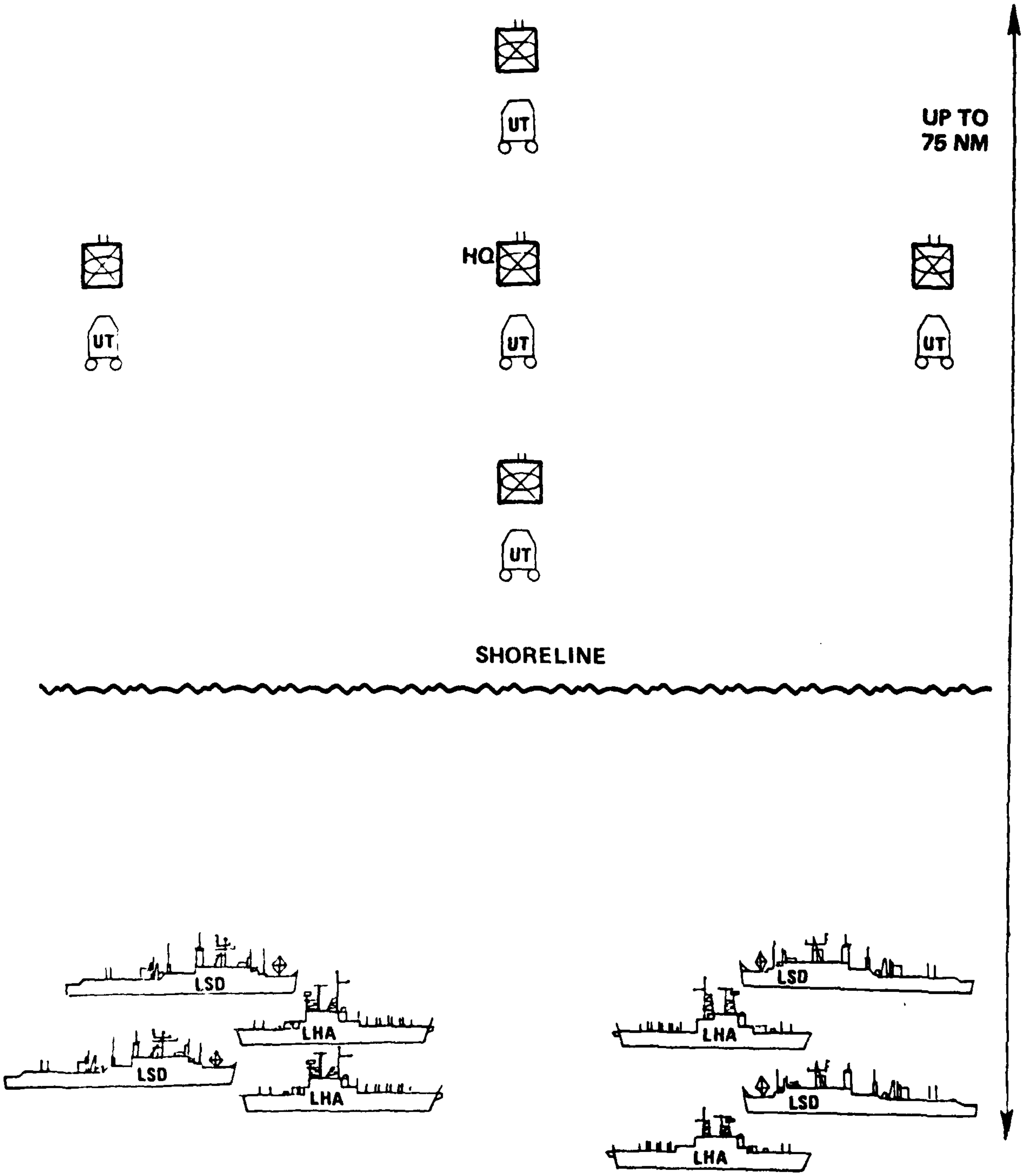


Figure ii. Direct Ship-to-MCATF Support Concept

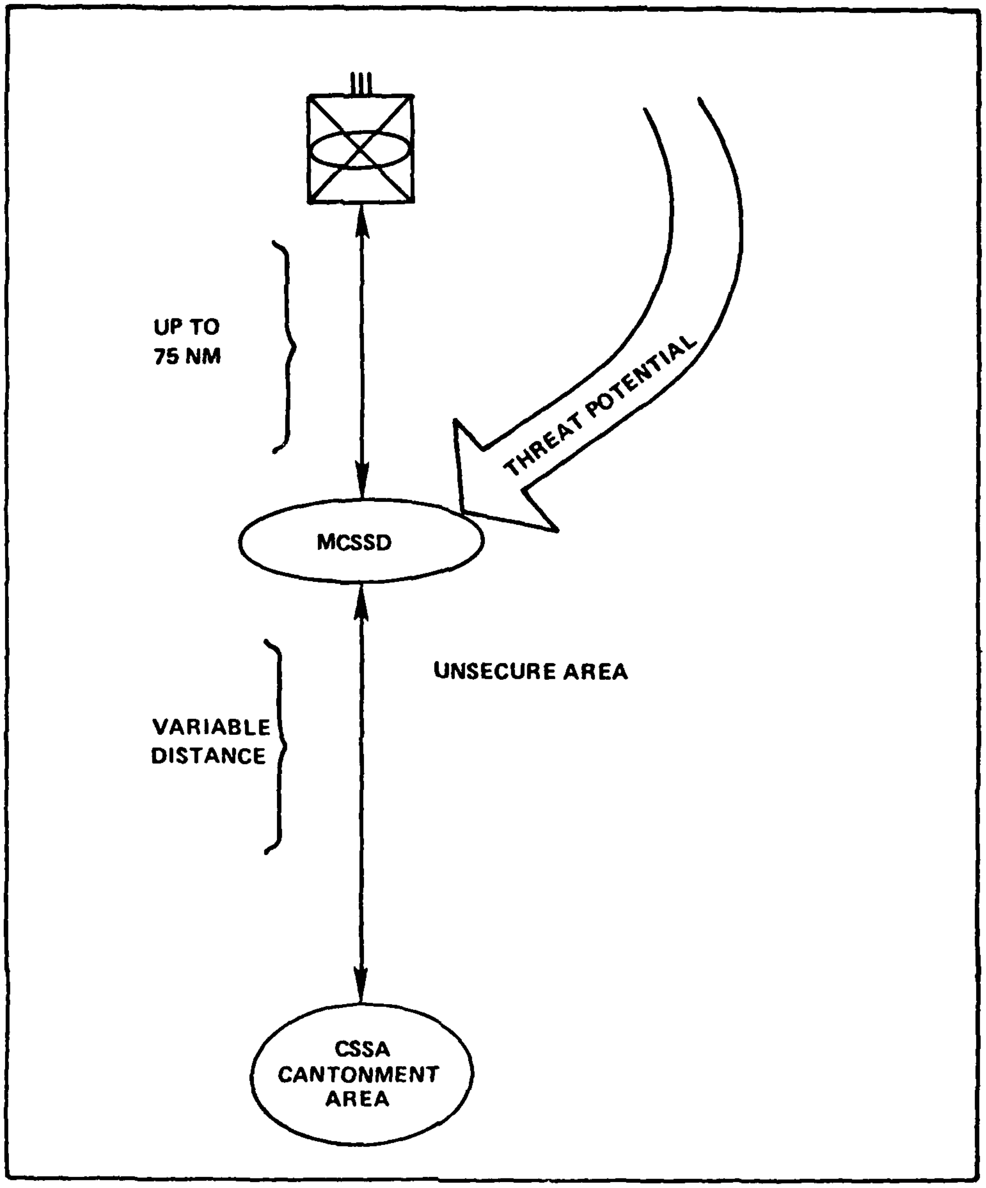


Figure iii. Illustration of MCSSD Vulnerability

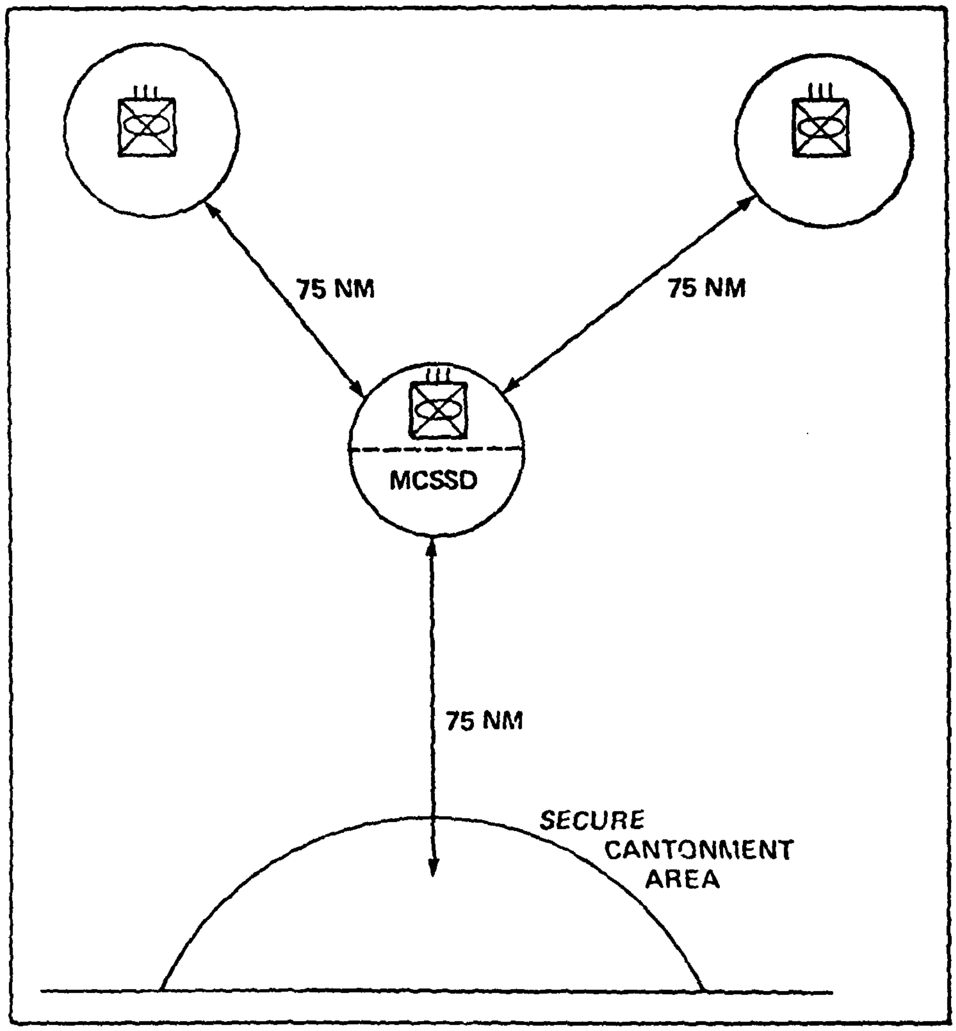


Figure iv. Example of 150 NM Penetration

In non-amphibious operations wherein the total force includes three regimental MCATFs, deeper tactical projections appear possible. Assuming the operational area extends inland along a major corridor and the threat becomes proportionately greater with distance penetrated, a concatenate support system could be used with MCSSDs collocated with and protected by a regimental MCATF. Figure v is illustrative of this concept. Therefore, maximum projection of a force containing three regimental level MCATFs may be approximately 225 NM from a secure cantonment area. Under certain environmental and threat conditions, this concept may even reach to 300 NM penetration. Independent Marine Corps projections of this depth are highly theoretical and situationally dependent and involve unconstrained CSS and helicopter assets. The tactical capability of a MCATF with collocated MCSSD is severely restricted.

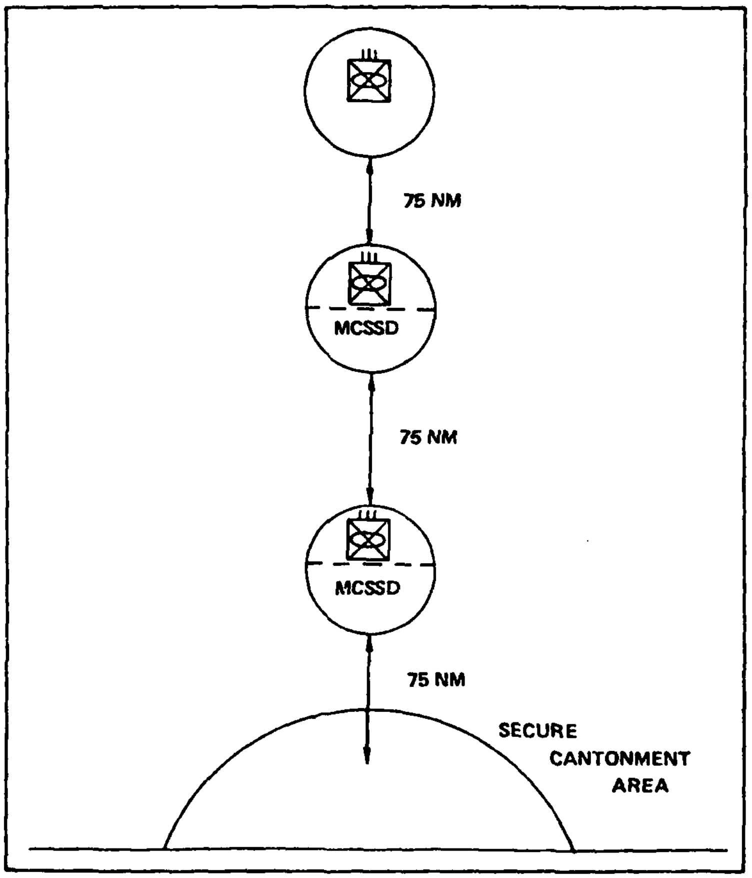


Figure v. <u>Support of Maximum Penetration</u>

Maintenance support of the penetrating MCATF will be based on the use of organic and on-call helicopter-lifted contact teams, on-site modular replacement, and increased use of the Operational Readiness Float. Decisions on repair vs recover vs abandon major vehicles will be made on a strict expected-time-to-repair basis.

Other CSS functions would need modified concepts to support tactical MCATF penetration operations. These are discussed in the main body.

MID-RANGE CONCEPTS

Mid-range concepts are focused on what is possible or feasible rather than conceptualization requiring new development programs. The central question is what improvements can be achieved in MCATF tactical and support concepts within existing or programmed systems? Part II of the study addresses this central question and includes a discussion of CS and CSS critical issues identified in the Post Exercise Evaluation of the MCATF-Phase IV operation. The tactical and support concepts of the long-range analysis (Part I) were used as goals for the mid-range.

Tactical Concepts

The mid-range tactical concepts for MCATF penetration are essentially unchanged from the long range, modified only to the extent that the support might be limited. For example, although amphibious operation without a stationary BSA is desirable, many specific situations may call for one or more BSAs to be established.

Combat Support Concept

It is unlikely that sufficient highly mobile ground reconnaissance elements will be available in the mid-range to provide the same type of coverage described in the long-range concept. Additional aerial reconnaissance will be needed to take up the slack.

There will be a limited amount of highly mobile (SP) artillery available in the mid-range. The artillery support concept makes use of the 155mm and 8" SP batteries available, and requires an off-road-mobile ammunition carrier.

Air and antiair support and engineer and communications support concepts are essentially unchanged from the long range.

Combat Service Support Concepts

Basic supply and resupply concepts are the same as in the long range, with extreme importance attached to helicopter resupply direct to the unit trains of MCATF maneuver elements. Limited transport helicopter resources and capabilities impose further constraints on the ease of penetrating to various depths. Operation of resupply helicopters in the mid-range is apt to be limited to a 50 NM radius with only rare instances where single-circuit support could be provided out to 75 NM. For a MAGTF with two or three regimental MCATFs, the centroidal-elliptical supply concept (figure vi) could be

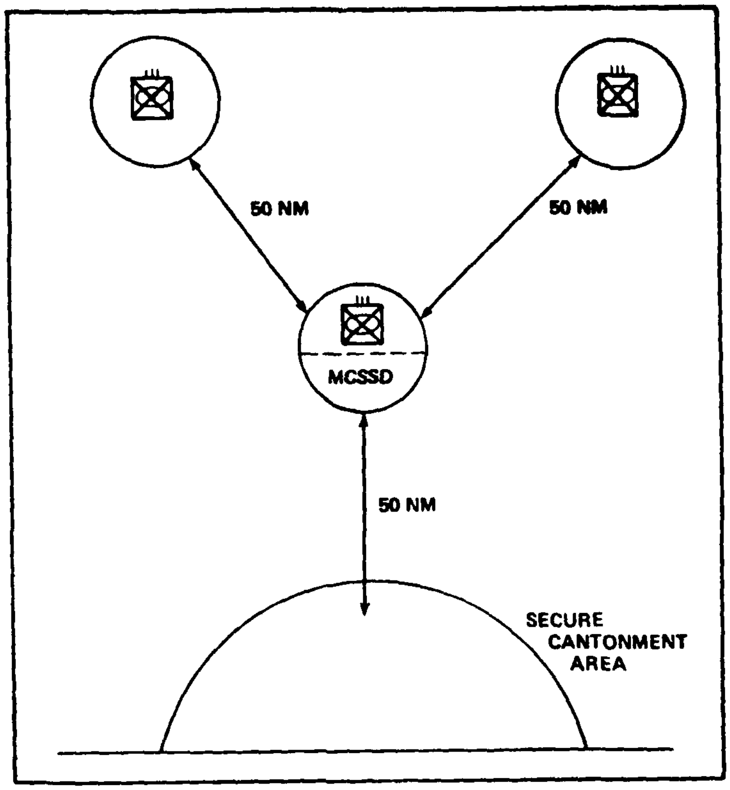


Figure vi. Illustration of Mid-Range MCATF Penetration

employed. In the rare situations in which the threat and resources would permit a concatenate-loop supply concept with more than one MCSSD, penetrations of approximately 150 NM might be supportable, but penetrations as deep as 300 NM could not be supported with acceptable risk in the mid-range.

Other CSS concepts would differ very little form the long-range.

FUEL DISTRIBUTION

Part III of the main body of the report presents an overview of the POL requirements and distribution concepts, the details of which are contained in Annex B. The most significant aspect of the analysis was the validity of using sixcon fuel modules as a primary container system for helicopter lift of fuel and subsequent distribution within the MCATF. Also of interest was the finding that AAFS, TAFDS and HERS type systems remain essential to overall capabilities.

CONCLUSIONS AND RECOMMENDATIONS

There is a feasible set of tactical, CS, and CSS concepts suitable for operation of MCATFs on deep penetration missions in the long range time frame. The CS and CSS concepts described require doctrinal, organizational, and equipment changes and improvements that are justified by the tactical flexibility and capability that they allow MCATFs to display in executing their missions.

It is recommended that these concepts be adopted as developmental concepts by the CG, MCDEC. It is also recommended that these concepts be considered as general guidance for the initiation and evaluation of advanced or exploratory development programs needed to provide the capability for effective MCATF operations in the long range time frame.

The tactical, CS, and CSS concepts described represent realistic goals for the conduct of MCATF operations in the mid-range, and would provide useful interim capabilities while moving to achieve the greater and more desirable capabilities outlined in the long-range concepts.

It is recommended that these mid-range concepts be adopted by CG, MCDEC as (1) guidance for POM initiatives to improve MCATF capabilities, and (2) a basis for improving contemporary MCATF concepts, techniques, testing, and evaluation.

BACKGROUND AND ORGANIZATION

1. INTRODUCTION

This report presents the results of a study conducted by Potomac General Research Group (PGRG) for the Naval Civil Engineering Laboratory (NCEL) of the Department of the Navy. The purpose of the study was to contribute to the identification of mid- and long-range development objectives of both equipment and doctrine. To accomplish this the study would investigate the expected operations and employment of a Marine Corps Mechanized Combined Arms Task Force (MCATF), both in the mid-range (1983-1992) and in the long-range (1993-2000), and construct concepts for the conduct of combat support (CS) and combat service support (CSS) compatible with MCATF characteristics. The MCATF concept was selected for investigation because it was expected to exercise severely CS and CSS elements due to its highly mobile, heavily mechanized nature and its diversity of missions. The study was intended to be highly conceptual and exploratory in nature, with emphasis on possible concepts to support the most flexible employment of MCATFs rather than on generation of optimal concepts based on hardware, manpower, and other resource constraints.

2. OBJECTIVES

The specific objectives of the study were to:

- Identify concepts in the mid- and long-range time frames for the combat support and combat service support in the prescribed environments.
- Identify the effectiveness and efficiency of the concepts in support of a MCATF.
- Identify deficiencies in current capabilities to meet the subsequently developed concepts.
- Identify a methodology for the development necessary to advance the current capability to the level required to meet the subsequently developed concepts.

3. GENERAL ASSUMPTIONS

The following general assumptions were provided for guidance at the initiation of the study and were observed except as noted below:

- The current worldwide mission assigned the Marine Corps will continue.
- The current doctrine of task organization for the Marine Corps MCATF employments will continue.
- The employment of the MCATF should be compatible with the Rapid Deployment Force (RDF) concept.

- The task organization will be capable of mechanized or airborne assault.

- The threat nations will continue to develop hardware and concepts of employment of more sophisticated equipments and procedures (e.g., mine laying and clearing systems).

- The Marine Corps Field Logistics System (FLS) will be established and executed throughout the time frame of interest.

4. MUTUAL MODIFICATION OF STUDY REQUIREMENTS

Among the general and specific requirements established in the statement of work were several that were the subject of discussion between NCEL and PGRG. These included requirements that:

- The contractor shall utilize the physical environments as provided in MARCORS 4 and 5.

- The contractor shall utilize a threat environment that will include a significant nuclear, biological, chemical (NBC) and radioelectronic capability by potential enemies.

- Special emphasis will be accorded to supply Classes I, III, V, and water, vehicle attrition, and packaging transition points.

In addition, there was particular interest in Class III supply requirements and methods that required much greater detail in the analysis of POL requirements and support concepts than was needed to define and select general CS and CSS concepts.

After review of the Statement of Work and proposed approach, NCEL and PGRG agreed that (1) the scenarios of MARCORS 1A and 5 would be suitable for the study, (2) the support function of greatest interest to the study is delivery of supply Classes I, III, and V, (3) the evolved concepts must be viable in an EW and CW environment, and (4) active tactical nuclear warfare need not be assumed.

The MCATF is a mechanized force, it is not assumed to be capable of effective airborne (i.e., parachute dropped) assault. The study would investigate the possibility of air-landed operations of the mechanized force. Helilift of light MCATF elements and air delivery of supplies would be examined. The approach selected was one which permitted PGRG the greatest latitude in identifying CS and CSS functions and penetration/supply concept permutations of sufficient importance to be analyzed in detail so as to conserve the limited resources for high payoff areas. Although the interest of the study was in the CS and CSS functions, the approved approach was one in which considerable effort would be required to define MCATF tactical concepts and to generate support requirements compatible with those concepts. The priority consideration for development of support concepts was that they should impose minimal constraints on tactical operations of the MCATF.

5. ORGANIZATION OF THE REPORT

The following sections describe the study methodology and review the CS and CSS functions and supply classes to determine the study scope. The next section concludes the general introduction with some comments on an operational concept for the Marine Corps in the long-range time frame. The results of the study are presented in three subsequent parts. Because the nature of the study was both exploratory and conceptual, it was decided to address the long-range time frame first with minimal constraints so as to generate a balanced MCATF with maximum tactical capability and flexibility. After constructing tactical and support concepts for the long-range, the mid-range was investigated utilizing a set of real-world constraints (on resource availability) that prevented the achievement of the desired long-range capability. The organization of the results reflects this approach, with Part I presenting the tactical and support concepts for the long-range, Part II presenting the results of accommodation to the constraints imposed by the mid-range, and Part III presenting an overview of fuel requirements and distribution concepts.

A detailed bibliography is presented in Annex A. The detailed examination of Class III requirements and associated equipment implications is presented in Annex B, separately bound for ease of review.

6. STUDY METHODOLOGY

As mentioned above, the study was conceptual in nature, calling for the formulation and exploration of ideas for tactical, CS, and CSS operations for which there is neither direct experience nor existing data base. The key element which would drive the creation of support concepts would be the requirements imposed and implied by the tactical concepts of operation of a MCATF for a deep penetration mission. Therefore, the first phase of the study concentrated on obtaining an adequate description of doctrine, task organization, missions and capabilities of various sized MCATFs in various environments. A review was conducted of available literature (manuals, historical accounts, studies, and related articles) concerning mechanized operations, penetrations and breakthroughs, amphibious assaults, and maneuver warfare.

Because the available material (see Bibliography, Annex A) did not provide an approved or acceptable set of tactical concepts, the study team constructed a set of concepts using the conditions of MARCORS 1A, as typical of the environment of an amphibious assault, and MARCORS 5, as typical of subsequent operations ashore, possibly as part of an RDJTF. These concepts were presented at a "mini-seminar" composed of highly experienced PGRG analysts and Marine Corps officers who were invited to critique and suggest changes. The much-improved concepts were then reconstructed by the study team and used as the desired objectives to define requirements for the CS and CSS functions.

The same procedure was used to construct concepts for each of the remaining CS functions and the major CSS functions. The study team reviewed the literature, constructed a trial concept for the function, discussed the concept in a seminar fashion with a group of highly qualified experts in that function, and then generated a revised concept or set of concepts for that function that were reasonable and provided adequate support for the demanding tactical operations. Concepts that were inconsistent with each other or that

were unreasonably demanding in terms of time, effort, or resources were discarded. The remaining concepts, their strengths and weaknesses, are discussed in Parts I and II below.

These remaining concepts are intended to be, and were assessed as being, quite versatile and generally applicable to situations worldwide in which Marine Corps MCATFs would be committed to penetration missions against a sophisticated threat that could include chemical, biological, and electronic warfare capability. The concepts are, of course, subject to minor modifications to account for environmental extremes (e.g., desert, arctic) or to take advantage of lesser threat capabilities (e.g., limited air or EW capability) in other situations.

7. REVIEW OF CS AND CSS FUNCTIONS AND SUPPLY CLASSES

7.1 Combat Support Functions

Combat support functions were identified from a review of applicable documents (FMFM 6-1, OH 9-3 (Rev. a), JCS Pub. 1, and others) and are defined for purposes of this study, as:

- Reconnaissance and Intelligence - The collection, processing, and dissemination of that knowledge of the enemy, weather, and geographical features required by a commander in the planning and conduct of combat operations.
- Artillery - Provide close and continuous fire support to elements of the landing force by neutralizing or destroying those targets which constitute the most serious threat, attacking hostile reserves, restricting enemy movement, disrupting enemy systems and installations, and attaining fire superiority over enemy delivery means.
- Naval Gunfire - Fire support delivered by ships' batteries (guns, rocket launchers, and guided missiles) to support troops and related surface and air operations.
- Close Air Support - Provides fire support from fixed wing or rotary wing aircraft against hostile targets which are in proximity to friendly forces.
- Antiair Defense - That action required to destroy or reduce to an acceptable level the enemy air and missile threat.
- Combat Engineers - To enhance the mobility of the MCATF by removing obstacles to its movement, to develop information on trafficability of areas for future operation, and to impede enemy mobility.
- Tactical Communications - To provide the tactical commander with the continuous capability to command assigned forces; to control and coordinate movement, supporting fires, and logistic support; and to collect and disseminate information.

Each of these combat support functions, except for naval gunfire, will provide significant support to MCATF operations in deep penetrations. Naval gunfire, if available, would be useful in protecting ship-to-shore movement, and engaging targets within range. The concept for its employment would not change materially or in such a way as to impact on the operation of a MCATF. Concepts for each of the remaining CS functions to support MCATFs will be constructed and examined in both mid-range and long-range time frames.

7.2 Combat Service Support Functions

FMFM 4-1 (Draft) identifies 24 combat service support functions and defines them as follows:

1. Supply. The procurement, distribution, storage, maintenance in storage, and salvage of all materiel to include requirements determination.

2. Maintenance. The action taken to retain materiel in a serviceable condition and/or to restore it to serviceability.

3. Transportation. The physical movement of resources-personnel and materiel, by water, air, and surface means to meet the requirements.

4. Engineer Support. Provide the personnel and equipment for construction, facilities maintenance, and utilities required to support the operations of the FMF.

5. Landing Support Operations. The means to support the waterborne landing and the movement of troops, equipment and supplies across beaches; to evacuate casualties and prisoners of war and provide HST/HSG support as required.

6. Medical/Dental. The provision of technical measures to safeguard the health of the command, early effective care of the sick and injured, and prompt and orderly evacuation of casualties.

7. Graves Registration. The collection, identification, disposition of personal effects, evacuation and temporary internment of the deceased and the establishment of maintenance of cemeteries.

8. Materials Handling Equipment. The provision and operations of equipment required for movement, loading/unloading of equipment cargo.

9. Financial Management. Those procedures and techniques that are applied to the control of resources to ensure that the appropriated funds are utilized within approved programs and budgets.

10. Automated Data Processing (ADP). The provision of the ADP system for functional tactical, and informational ADP systems. This includes control over information reporting, data systems development, and associated ADP equipment operations.

11. Embarkation. The determination of requirements for air or surface lift of materiel of the command, and the supervision of the loading and unloading of those materiels.

12. Nontactical Communications. The communication capability required to provide for internal communications of the combat service support element and to provide the terminals for external communication capability.

13. The provision of rations to the personnel of an organization, which includes mess management and subsistence accounting.

14. Postal. The primary means for the transmission of official communications, material, and personal mail including maintenance and operation of postal services in support of military operations.

15. CSS Training. Training designed to qualify individuals, units, and staffs to perform functions effectively in combat service support roles.

16. Military Police

a. Law Enforcement. Execution of regulations and law enforcement, to include police protection and control and disposition of stragglers.

b. Security. Provisions of physical security to facilities or areas of a command, to include reaction forces and canine support as required.

c. POW Management. Supervision of the collection, guarding, and evacuation of prisoners of war, to include the transfer of POWs to agencies external to the MAGTF.

17. Exchange Services. Initially, those services limited to the provision of health and comfort and necessity items and subsequently the operation of exchanges.

18. Passenger and Freight Transportation. Management operations that provide for the receipt, shipment, and forwarding of materiel and personnel.

19. Legal. Assistance provided a command concerning military justice, legal assistance, civil-military relations, and international law.

20. Special Service Clubs. The provision of recreation athletic programs, clubs and supporting services to the command to include the accounting for appropriated and non-appropriated funds and the provision of supplies and facilities for these activities.

21. Civil Affairs. The supervision of collection control, care and evacuation of civilian and resource activities that affect military operations. This includes all collection of intelligence from civilian resources as well as the planning and distribution of supplies and equipment to meet minimum civilian need.

22. Administration. The management and execution of all military matters in the fields of logistics and personnel management.

23. Ecclesiastical Services. Provision of guidance and service in areas of moral, spiritual, and religious welfare to a command.

24. Means for the commander to stimulate and maintain morale and to provide for internal security within the command post.

A rapid review of these functions, and the associated subfunctions and tasks described in FMFM 4-1, identified ten functions that are oriented primarily to support of CONUS or theater non-tactical operations, and have little relation to the operation of a MCATF in the field. These ten functions (9. Financial Management, 10. Automated Data Processing, 11. Evaluation, 12. Non-tactical Communications, 15. CSS Training, 18. Passenger and Freight Transportation, 19. Legal, 20. Special Services Clubs, 22. Administration, and 24. Band) were eliminated from further consideration in the study.

A somewhat more detailed examination of the remaining functions identified five more functions that, while they contribute to support of a MCATF in the field, are not considered critical to its tactical operation. While the concept of support of these functions (7. Graves Registration, 14. Postal, 17. Exchange Services, 21. Civil Affairs, and 23. Ecclesiastical Services) would be modified slightly to accommodate to the requirements of a MCATF on a penetration mission, their importance did not warrant further investigation in the study.

The remaining nine CSS functions (1. Supply, 2. Maintenance, 3. Transportation, 4. Engineer Support, 5. Landing Support Operations, 6. Medical/Dental, 8. Materials Handling Equipment, 13. Food Service, and 16. Military Police) are discussed below in both long- and mid-range time frames.

7.3 <u>Classes of Supply</u>

The classes of supply are also defined in FMFM 4-1. These are:

<u>Class I</u>. Subsistence including gratuitous health and welfare items. ...

<u>Class II</u>. Clothing, individual equipment, tentage, organizational tools and tool kits, hand tools, administrative, and housekeeping supplies and equipments. ...

<u>Class III</u>. Petroleum, oils, and lubricants: petroleum fuels, lubricants, hydraulic and insulating oils, preservatives, liquid and compressed gases, bulk chemical products, coolants, deicing and antifreeze compounds, together with components and additives of such products, and coal. ...

<u>Class IV</u>. Construction: construction materials to include installed equipment and all fortification barrier materials. ...

<u>Class V</u>. Ammunition: ammunition of all types (including chemical, biological, radiological, and special weapons), bombs, explosives, mines, fuzes, detonators, pyrotechnics, missiles, rockets, propellants, and other associated items. ...

Class VI. Personal demand items (nonmilitary sales items). ...

Class VII. Major end items: a final combination of end products which is ready for its intended use; e.g., launchers, tanks, mobile machine shops, vehicles. ...

Class VIII. Medical materiel including medical peculiar repair parts. ...

Class IX. Repair parts and components to include kits, assemblies, and subassemblies, reparable and nonreparable, required for maintenance support of all equipment. ...

Class X. Materiel to support nonmilitary programs; e.g., agricultural and economic development, not included in classes I-IX. ...

Class VI (personal) and class X (nonmilitary) supplies are clearly not relevant to MCATF operations and will not be addressed in the study. Classes II (clothing) and VIII (medical) are clearly significant, but they represent such a small percentage of the total supplies that they do not contribute to the development of a supply concept. Necessary resupply of classes II and VIII will occur under whatever concept is developed to provide supplies to the MCATF. The remaining supply classes will be discussed in developing a concept to support the tactics appropriate for a MCATF in a penetration mission.

8. OVERVIEW OF MARINE CORPS LONG RANGE OPERATIONAL CONCEPTS

It should be noted that the draft Marine Corps Long Range Plan (MLRP) was used as a basic reference in the analysis and synthesis of the concepts presented in this report. The MLRP has since been approved, however, it may not be widely distributed before this study report is received by the project sponsor and other interested agencies. Therefore, the following synopsis of the operational concept is provided for the reader who has not had access to the draft plan; the synopsis is an extract from Annex A of the draft.

"4. OPERATIONAL CONCEPT

a. (U) The future concept for employment of Marine Corps forces, and necessary supporting concepts, are based upon assigned functions of the Marine Corps, forecast trends in the international environment, and the forecast Marine Corps role in the National Strategy as set forth in the Marine Corps Long Range Study and Marine Corps Long Range Plan. A summary explanation of the future operational concept contained in the MLRP may be found on pp 1-14 thru 1-24 of Chapter 1. A synopsis of the concept is provided below.

b. (U) Based upon an analysis of the above factors, a general shift in U.S. strategy is predicted toward an increasing reliance on naval power as the focal point of military strategy in the future. This shift will cause increased demands on the readiness, versatility, responsiveness and utility of the Marine Corps. The nature of future conflict/crisis arenas and most likely adversarial forces will continue to mandate a capable array of amphibious force power projection options. However, emphasis as to the most effective means is shifting as new threats and interests emerge. To further define the role of amphibious forces,

certain refinements to existing amphibious doctrine are emerging as a conceptual focal point for future more effective employment of Marine Corps forces in support of the naval strategy. The amphibious concept addresses the critical need for timely response to those conflicts which are projected as having the higher probability and frequency of occurrence in the long range period. Such conflicts are expected to be highly fluid, very lethal, and extremely intense in nature and concluded in a relatively short time. In such conflicts, timely execution of missions with measured military force is essential to achieving national objectives, preventing escalation of the conflict situation and displaying national willingness to apply military force should diplomatic endeavors fail.

c. (U) In response to a changing threat, changes in national strategy, and technological developments, a reexamination of the essence of amphibious techniques provides a window for shifting the conceptual focal point of amphibious tactics. Doctrinally, (LFM-01), the essential usefulness of the amphibious operation stems from mobility and flexibility, exploiting the element of surprise and capitalizing on enemy weaknesses. The central theme gleaned from LFM-01 is one of capitalizing on the inherent characteristics of the amphibious task force (ATF) in order to employ a maneuver style of sea-air-land warfare. Strategically, maneuver is the very essence of the Marine Corps role as a national force projection asset, particularly as part of the Navy-Marine Corps team in the conduct of amphibious forcible entry operations, for the concentration of superior combat power, at a time and place of the attacker's choosing, before the enemy can react, is the essence of maneuver warfare.

d. (U) The amphibious assault can be characterized as a <u>rapid forcible entry</u>, followed by <u>exploitation</u> and, ultimately, <u>extraction</u>. Tactically speaking, it is virtually a <u>surprise offensive</u>, launched from the sea, capitalizing on unpredictability and responding rapidly to fleeting opportunities to throw <u>strength against weakness</u>. It capitalizes on the strategic mobility of amphibious ships complemented by the tactical mobility of vertical envelopment to maneuver around and behind enemy coastal defenses to execute missions inland from a coastal area. With possible elimination of the shoreline interface, forces would necessarily rely on sophisticated mobile logistics support and imaginative planning for aerial umbilicals to supporting ships.

e. (U) An amphibious task force is a naval force, a balanced <u>Navy-Marine Corps team</u>. Such a force is task organized for a specific mission from units with deployed Fleet and deployed from other fleets as necessary. It is <u>fast moving</u> and <u>hard hitting</u>, and embodies the best <u>balance</u> of strategic and tactical mobility, firepower and logistic self-sufficiency that task organization of Navy and Marine Corps assets can accomplish for a given place, time, and mission. Amphibious plans and dispositions are kept flexible and adaptable to circumstances, and call for operations which can meet alternative objectives. The application of mobility and deception are fundamental to successful execution of the amphibious operation. Strategic/tactical maneuver and strategic/tactical surprise are employed to pursue the course of action least expected, thereby distracting and dislocating the enemy, depriving him of his

freedom of action and leading to his destruction. Commanders and planners at all levels must exercise aggressive opportunism in seeking to avoid the deliberate and predictable tactic of the frontal amphibious assault."

PART I--LONG RANGE

I-1. INTRODUCTION

Combat Support (CS) and Combat Service Support (CSS) concepts are inevitably linked to the tactical concepts or techniques of ground maneuver elements. Contemporary tactical concepts and techniques for the MCATF are evolving through phased testing and evaluation at the Marine Corps Air Ground Combat Center (MCAGCC). These concepts and techniques are recorded in evaluation reports and in Operational Handbook (OH) 9-3, Mechanized Combined Arms Task Forces (MCATF). The current edition of the handbook, Revision A, March 1980, was used as a basic reference for this study.

Tactical concepts and techniques for the long range period were derived from evaluation of contemporary concepts, a series of studies and analyses recently performed by PGRG, PGRG seminars, a general review of the literature, and from principles enunciated in the draft Marine Corps Long Range Plan (MLRP). The derived tactical concepts focus on a "maneuver style of warfare" in the long range period. This style of warfare is distinctly different from its alleged antithesis: "firepower--attrition." In paragraph I-2 below, an explanation of this style of warfare is provided as a basis for the CS and CSS concepts that follow. In constructing these concepts the study team selected certain current or projected vehicles, weapons, and equipment as illustrative of the generic capabilities necessary to implement the concept. Any available item with similar generic capabilities would satisfy the concept.

CS and CSS concepts related to MCATFs are also influenced by the size of the MAGTF, and its mode of tactical employment, i.e., amphibious or nonamphibious. For this study, two basic sizes of MAGTFs were used as representative of Marine Corps contingency tasking. One has a single regimental MCATF containing four battalion level maneuver elements. This MCATF uses the mechanized assets of one division in either an amphibious or nonamphibious operation. The second size is representative of Rapid Deployment Joint Task Force (RDJTF) commitments under the Rapid Deployment Force (RDF) concept wherein the Marine Corps provides a one-division MAF and up to three additional brigades related to the Maritime Prepositioning Ship (MPS) aspect of the RDF concept. Each of these brigades is considered to be another regimental MCATF. For purposes of this study a total force containing three regimental MCATFs was selected as the second size of MAGTF. Figure I-1 portrays this level MCATF capability configured for nonamphibious warfare representative of a composite MAF (in theater) about Alert Day +35. The tactics, capabilities, and limitations of a battalion-sized MCATF conducting independent operations as part of a MAGTF mission were also investigated for both light (Light Armored Assault Battalion-LAAB) and heavy MCATF battalions.

I-2. TACTICAL CONCEPTS--THE MCATF AND A MANEUVER STYLE OF WARFARE

The term "maneuver warfare" is highly visible in contemporary professional publications. However, there is no general consensus on exactly what maneuver

warfare is nor what it means to the U.S. Marine Corps and the MCATF. Over the past two years, PGRG has reviewed all pertinent literature on the subject with special focus on contemporary writings in The Marine Corps Gazette. While the articles continue to appear--and to differ on some aspects and implications of maneuver warfare--some basic perceptions, particularly applicable to Marine Corps mechanized operations, can be formulated. Specifically it is suggested that a maneuver style of warfare will be applicable to MCATF tactical concepts and that it will be a unique style, a style evolved by Marines, a style that will suit Marine Corps MCATF operations in both amphibious and nonamphibious mode. The concept fundamentals of this style are addressed in Operational Handbook (OH) 9-3 (Rev A), March 1980, Mechanized Combined Arms Task Forces (MCATF), and in Education Center Publication (ECP) 9-5, Marine Amphibious Brigade Mechanized and Countermechanized Operations, 20 January 1981. Table I1 depicts the concept fundamentals as contained in OH 9-3 (Rev A); Table I-2 depicts reinforcing extracts from ECP 9-5.

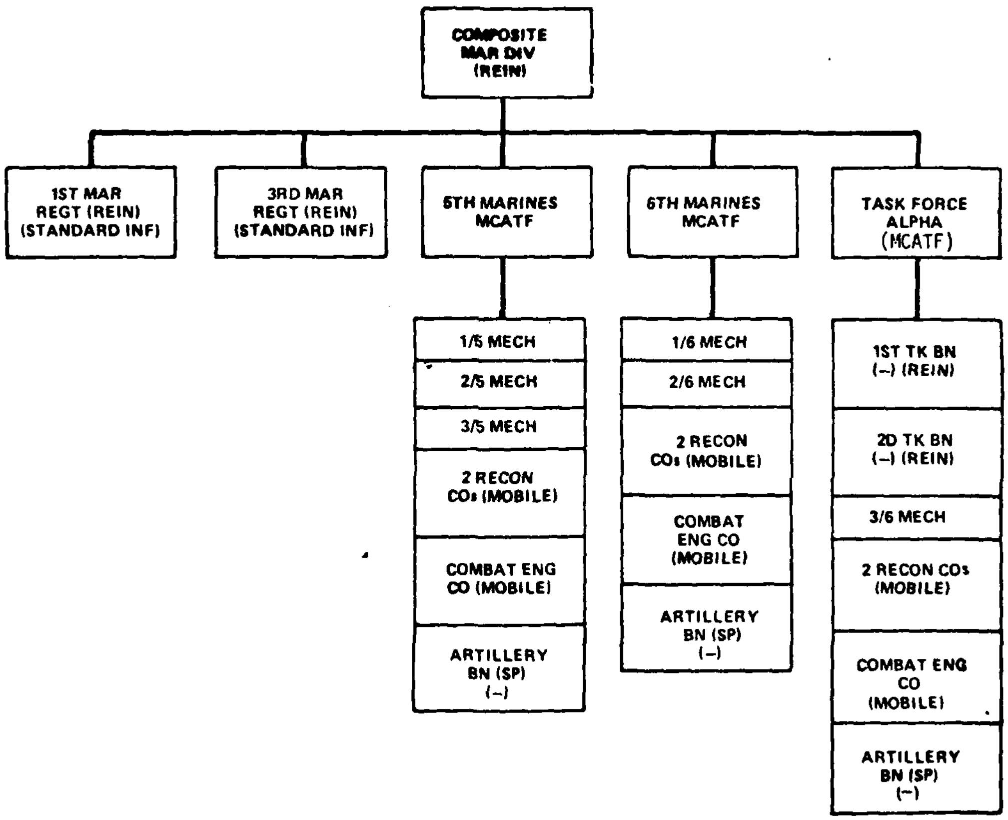


Figure I-1. Representative RDJTF Commitment Containing Three Regimental Level MCATFs

Table I-1. Fundamentals of the Maneuver Style of Warfare

OH 9-3 (Rev A)

202. CONCEPTS

In many situations, MCATFs will be outnumbered and outgunned. An attrition contest, relying on firepower, is not likely to bring a positive result. Therefore, MCATFs must be prepared to USE MANEUVER WARFARE. Commanders are responsible for understanding the concepts of maneuver war and applying them on the battlefield.

Maneuver warfare is an overall STYLE OF WARFARE. It seeks to DISLOCATE, DISRUPT and DISORIENT the opponent, DESTROYING HIS COHESION, rather than destroying him piece-by-piece with firepower. In maneuver war, the MCATF seeks to create SUCCESSIVE UNEXPECTED and THREATENING situations for the opponent. The opponent should be brought to see his situation NOT JUST AS UNFAVORABLE OR DETERIORATING; he must see it as DETERIORATING AT AN EVER-INCREASING PACE.

Maneuver warfare uses both fire and maneuver. However, in general, fire is used TO CREATE FAVORABLE CONDITIONS FOR MANEUVER and to ANNIHILATE UNITS WHOSE COHESION HAS BEEN SHATTERED, not to engage cohesive enemy units head-on in an attrition contest.

Tactics emphasize RESPONDING RAPIDLY TO FLEETING OPPORTUNITIES TO THROW STRENGTH AGAINST WEAKNESS. Attacks seek gaps in enemy positions and pour reserves through them, rolling out behind the enemy to encircle him. Defenses place only a "tripwire" forward to absorb the enemy's attention, destroying him by counter-attacks into his flanks as he penetrates.

Tactics are RECON-PULL, not COMMAND-PUSH. The POINT OF MAIN EFFORT and THE AXIS OF ADVANCE shift continuously in response to opportunities. Therefore, MISSION-TYPE ORDERS ARE A REQUIREMENT. Subordinate unit commanders act on their own initiative within the COMMANDER's INTENT.

Table I-2. Fundamentals of the Maneuver Style of Warfare

LCP 9-5

BASIC PRINCIPLES

". . .

A. The primary objective of the force employed must be the destruction of the enemy's combat effectiveness. . . .

B. The enemy must be continuously exposed to the full combined array of our weapons and potential threats. Stereotyped operations must be avoided with emphasis on flexibility. . . . The commander must orient on the enemy rather than terrain. . . .

C. . . . . The battlefield of the future will reward the side maintaining the initiative, flexibility, and freedom of maneuver."

Confirmation of these principles as guiding tactical concepts in the long range period is contained in the draft MLRP. Table I-3, extracted from the briefing materials on the draft MLRP, provides a comparison between current and maneuver styles of warfare. This comparison, together with the work cited above, formed the basis for the development of tactical concepts of operations for the MCATF in penetration missions. The distinctive features of these concepts, refined by the review and revision methodology in phase one of the study, can be summarized as follows:

- The MCATF is omnidirectional with maneuver elements separated on the battlefield.
- There is no forward edge of the battle area (FEBA) per se.
- There is no secure rear area immediately "behind" the MCATF nor any secure main supply route (MSR).
- There is normally no beach support area (BSA) in the amphibious mode.
- Equal or compatible mobility and survivability is required for all systems and equipment on the MCATF battlefield.
- There is a confirmed definitional trend and focus: Mechanized Combined Arms Task Force.

Integration of tanks and amphibious assault vehicles (AAVs) into the maneuver elements of the MCATF is only the first step in evolving combined arms tactics and techniques. Although there is no official definition of combined arms in JCS Pub 1, it is generally accepted that combined arms involves attacking an enemy with two or more weapons systems simultaneously in such a manner that any action the enemy takes to avoid or minimize the effect of one system makes him more vulnerable to another.

In warfare with both sides reflecting these fundamentals, the concept of "penetration," as in a penetration of static enemy positions, is not very useful. The separated maneuver elements of a MCATF may often be intermingled with enemy elements. When terrain no longer defines basic objectives, most of the operational area becomes a "no-man's-land" with value only to support the presence or passage of forces, as the ocean supports a fleet. Penetration

Table I-3. Comparison of Warfare Styles

	Current Perception	Maneuver Perception
Target	Key terrain	The enemy Priority on C^2, service support
Approach	Direct Unidirectional	Indirect Omnidirectional Isolate Destroy Disrupt Impede Sever Avoid
Measurable Gain	Terrain	Ultimate disruption and destruction
Use of Defense	Obstacle in path of enemy	Bait to alter his path
Offensive Operations	Terrain oriented Seize Occupy Defend	Enemy oriented Seek Engage Destroy
Nature of Battle	Predictable	Fluid
Battle Phasing	Distinct Movement Attack Assault Defend	Non-distinct Movement Attack Movement Attack Retire/abandon/temporarily defend Movement Retire/abandon/temporarily defend, etc.

distances as used in this study are conceived as distances of reach or projection into this "no man's land" from relatively secure bases either afloat or ashore.

I-3. COMBAT SUPPORT CONCEPTS

Each of the following CS functions makes a contribution to maneuver warfare and MCATF penetration operations that is significant to the execution of the tactical concept. The organization, operation, and equipment related to these functions were examined in seminars conducted by the study group among PGRG analysts of considerable experience in each functional area. Each group was impressed with the importance of the function and the necessity to adapt to the requirements created by the tactical concept in the long range. Reconnaissance and intelligence become even more important than usual as they provide information for the constantly changing and flowing operations in what is described as "recon-pull" tactics. Artillery, close air support and antiair defense are integral parts of the combined arms concept. Combat engineers are charged with keeping the movement in maneuver warfare, and good tactical communications provide the strings of control which keep this widely spread, rapidly moving force from disintegrating into uncoordinated, independent elements, each highly vulnerable to enemy action. The essentials of an operational concept for each of these CS functions that is required to support the MCATF tactical concept are given below. Those who participated in their development recognize that only the surface has been scratched, and that each of the CS functions should be examined in detail to identify the organizational, resource, training, and operational implications of MCATF application of a maneuver style of warfare.

I-3-1. Reconnaissance/Intelligence

Three aspects of the maneuver warfare tactical concept heavily impact on the requirement for reconnaissance and intelligence support. First is the deep penetration of projection of the MCATF away from a secure area and into a no-man's-land that converts reconnaissance from a one-dimensional to a two-dimensional problem, covering the entire area surrounding the MCATF operations. Equally important is the increase in speed and distance of maneuver, of both friendly and enemy forces, which requires a corresponding increase in distance and area of coverage to provide adequate intelligence generation and response time. Finally, the recon-pull aspect of the concept de-emphasizes "reconnaissance-as-target-acquisition" and places more stress on data collection for intelligence production to project enemy disposition, capabilities, intentions, organizational and tactical strengths and weaknesses, etc.

To meet these requirements the following organizational changes are postulated:

- A mobile/mechanized reconnaissance (recon) company will be organic to a regimental MCATF.
- The Marine division recon battalion will contain additional mobile/mechanized companies.

- Regimental and battalion level intelligence sections will be increased.

The following employment concepts are envisioned in support of a regimental level MCATF.

- Elements (platoons and/or teams) of the recon company organic to a MCATF may be in direct support (D/S) of the maneuver battalions most of the time. They could also be attached to the maneuver battalions or serve in a general support role under the operational control (OPCON) of the MCATF commander. One or more mobile recon companies of the recon battalion would commonly be attached to or placed in D/S of a MCATF.

- Ideally, recon elements would operate 4-6 hours "out" from the maneuver battalions and could include tank, mechanized infantry, and/or artillery attachments.

- Recon elements from both the organic company and the recon battalion will be employed on a semi-continuous basis (missions over extended times). Due to the high criticality of recon-pull tactics in a maneuver style of warfare, it does not appear possible to make recon units completely mission self-sufficient and to rotate them frequently. There will not be enough recon assets to hold a sufficient number in reserve as a rotation base (mission tasks exceed assets). This means recon units will require some demand-pull supply support, particularly Class III.

- There will be more intelligence <u>production</u> at both the regimental and battalion levels with a demand for near-real-time intelligence.

- Airborne recon and surveillance systems will complement and extend mobile recon element capabilities. These systems must be multi-sensor platforms with near-real-time readout capabilities.

In summary, the MCATF must have highly effective, mobile recon assets, both organic and either attached or in D/S. Both the MCATF commander and his maneuver element commanders must have near-real-time intelligence. A maneuver style of warfare makes real-time intelligence an integral element of combat--in fact, the <u>key</u> element.

I-3-2. <u>Artillery Support</u>

Artillery support for a MCATF would need the capability to support both the entire regimental organization and its component maneuver elements as they move rapidly over the area of operations separated from each other by distances approaching the maximum range of artillery weapons (25-30 km). High closing speeds of opposing forces increase the requirement for fire missions at or near maximum range beyond the maneuver elements. Interdiction/area denial and suppressive fire missions increase in importance as a means of inhibiting enemy maneuver and increasing friendly maneuver advantage. Counterbattery exchanges and intense preparatory fire would occur less frequently.

A major change in the organization of artillery support for a MCATF regiment is postulated to meet these requirements. Specifically, a notional, five-battery battalion would be organized as part of a MCATF regiment. This battalion would contain four 155mm (SP) batteries and one multiple launcher rocket system (MLRS) battery. Each 155mm battery would contain eight enhanced self-propelled artillery weapons systems (ESPAWS) with two platoons, each with four tubes. The MLRS battery would be composed of four platoons, each with three launchers. The notional battalion, depicted in figure I-2, satisfies minimum requirements in a combined arms mode; reinforcement from division assets, when required, would be by attachment to the MCATF artillery battalion to form an artillery group.

Artillery firing batteries can function under the fire direction of the battalion, however, due to the potential separation of ground maneuver battalions from each other, the basic concept is attachment of 155mm SP batteries to the four maneuver battalions with individual battery fire direction. This provides extended range fire support capabilities to each maneuver element. It also provides some security for these batteries and reduces the number of unit trains on the battlefield. The disposition and employment of the MLRS battery is more situationally dependent. It could be attached by platoon to the 155mm SP batteries, or it could be used to increase artillery support for maneuver battalions conducting a critical mission.

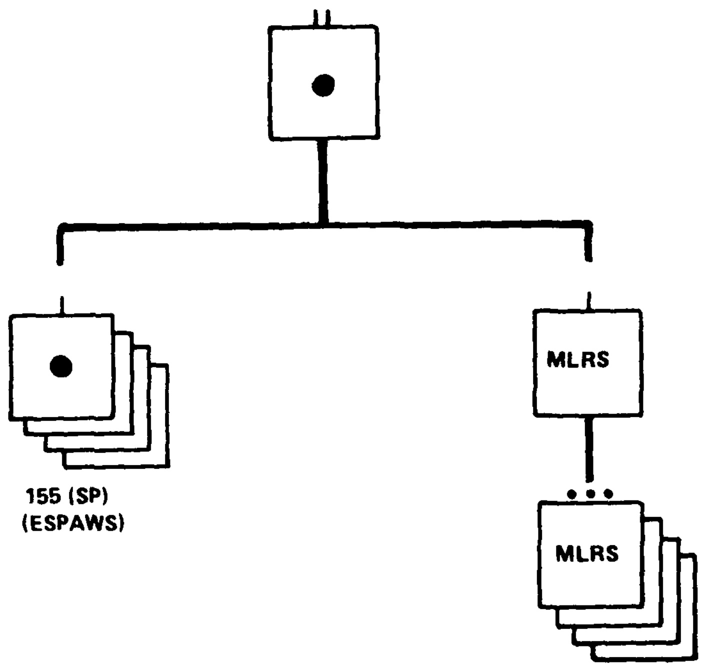


Figure I-2. Notional Artillery Battalion (SP)

I-3-3. Close Air Support

The battlefield of the MCATF is both larger and more fluid than in more conventional operations. Successful and responsive fire support by fixed wing and rotary wing aircraft is both more important, because of the difficulty of rapidly reinforcing artillery support, and more difficult, because of (1) the probability of encountering enemy air defenses anywhere around the MCATF maneuver elements, and (2) the mobile and fleeting nature of the targets. The concept of "recon-pull" operations will be as significant for air operations as for ground, permitting air strikes to exploit relative enemy weaknesses and to avoid engaging in attrition operations that could dilute support of the maneuvering MCATF. The concept of combined arms implies that ground combat power can be used to destroy or suppress enemy air defenses just as airborne firepower can be directed against ground defenses.

The need to provide viable, effective close air support for MCATFs in penetration missions will require careful planning to assure adequate bases for the supporting aviation elements. Although fixed-wing tactical aircraft can provide effective air support out to several hundred miles from their bases, the location of theater air bases and aircraft carriers frequently will be 100-200 NMs from the objective shoreline during the initiation of amphibious operations. This standoff constraint coupled with the need to provide effective antiair operations, aerial reconnaissance, and deep offensive air support well beyond MCATF forces ashore, would counsel constraining initial MCATF penetrations to distances of less than 100 NMs. Deeper penetrations would need to be accompanied by movement of the support bases or carriers close to the objective area.

A primary aviation element of the combined arms team is the attack helicopter (AH) operating in direct support (D/S) of the maneuver elements. It will operate from a deck alert or ground loiter vice a full time airborne alert status. Rapid reaction and pre-assigned D/S tasking means the pilots must have an accurate, up-to-date awareness of the battle; a direct communication link from the maneuver battalion tactical air control party (TACP) to the cockpit at the ground/deck alert site. The estimated reaction time from launch site to target area normally would be 15 minutes per 25 NM, with refueling and rearming at launch site. The AH also has a *de facto* role in D/S airborne reconnaissance which is essential to recon-pull tactics.

Fixed-wing V/STOL attack aircraft would use established concepts for supporting MCATFs. Rearming and refueling would be accomplished at sea bases and sea platforms as well as at facilities or main bases ashore 40-100 miles from the tactical battle areas. These aircraft would maintain a deck/strip alert posture from these points or could stand by at forward sites in a secure area nominally at least 20 NMs from the battle area.

Fixed-wing aerial reconnaissance requirements may either drive or "piggyback" on combined air strikes in high threat environments.

I-3-4. Antiair Defense

Antiair support for MCATFs on deep penetration missions will rely heavily on the counterair operations of supporting aviation. Lack of a designated secure operating area on the ground will make it difficult if not impossible to establish an effective, overlapping, ground-based antiair defense. Fighter/interceptor support will be relied on to pick up the slack.

For point- and small-area defense, mobile air defense systems are attached to the MCATF which provides movement control, protection, and logistic support. For purposes of this study a light armored vehicle (LAV) air defense variant was postulated as a representative system. Operational control (OPCON) or control of the firing conditions is centralized within the total air defense system of the MAGTF.

I-3-5. Combat Engineer Support.

Combat engineers in support of a regimental MCATF have dual missions of enhancing the maneuverability of the force and helping to impede the maneuverability of the enemy. They must perform these missions without compromising the mobility of the task force of which they are a part. Of the several engineer tasks that they currently perform, light obstacle breaching, wet and dry gap crossing, hasty defense preparation, and hasty minefield emplacement and clearing will be of great importance. Preparation or breaching of extensive fortifications, route preparation or maintenance, and most forms of horizontal and vertical construction will seldom if ever be required. Clearing and maintenance of helicopter landing zones (LZs) will be extremely important.

To provide this support, a reinforced combat engineer company (mobile) would be attached or organic to a regimental level MCATF. The MAGTF engineer battalion would provide on-call special capabilities afloat or in a secure cantonment area. Mobile combat engineer teams or squads would commonly be attached to all maneuver element companies. They would use an advanced vehicle such as a LAV-E and/or LVTX-E. Emphasis will be on rapid and reliable mine clearing and hasty barrier erection and breaching. An experienced combat engineer would also be employed with recon elements. A gap crossing capability in the form of an armored vehicle-launched bridge (AVLB) will be organic to the engineer company.

I-3-6. Tactical Communications Support

The principal consideration affecting communications support for MCATF operations is the greatly increased intra-command distance. Current communications concepts rely heavily on continuous, and continuously interactive, communications among command elements. Neither of these desirable conditions may be considered dependable for MCATF operations. Instead, the C^3 concept must be built around long range, high frequency (HF) systems and airborne/satellite relay systems with prospects for intermittent interruption of communications. This places greater emphasis on tactical skill and training to achieve the coordination essential to a maneuver style of warfare.

The MCATF tactical concept indicates an even greater need for accurate, essentially real-time position-location information (PLI) than in non-mechanized operation. This PLI, of both friendly and enemy elements, will need to span distances much greater than are now considered operationally feasible. Both the area of interest and the equipment providing PLI will move rapidly around on the battlefield.

Inter-command communications, between the MCATF and other elements of the MAGTF must also span distances (75 to 100 miles or more) not currently contemplated. These communications must serve three distinct functions which may place different requirements on the communications nets:

- Close coordination with those aviation elements of the combined arms team that are not operating out of the MCATF area, and with the sources of intelligence and intelligence information that are essential to the "recon-pull" type of operations planning.

- Rapid response to requests for supply/replacement/maintenance support and other support essential to maintain the maneuverability of the MCATF.

- Dependable channels for transmission of information and direction between the MCATF commander and the higher headquarters charged with coordinating his activity with other forces in the theater.

I.4. COMBAT SERVICE SUPPORT CONCEPTS

The MCATF tactical concepts and CS concepts defined in the preceding paragraphs collectively serve as the basis for designing the CSS concepts. In analyzing the long-range time frame, the study team took particular care to develop CSS concepts that introduced minimal constraints on desired tactical capabilities and operations.

I-4-1. Supply and Transportation Concepts

The supply and transportation functions are inextricably interrelated. The support concepts were developed together to be mutually supportive and consistent. The general concepts will be discussed first, and then the implications will be applied to different MAGTF operation to illustrate the advantages and disadvantages of the various types of supply circuits in different mission criteria.

Primary MCATF organizational focus has been placed on a semi-permanently organized, regimental-sized MCATF. The regimental level MCATF is notionalized with four battalion-level maneuver elements and a headquarters element; it serves as a base case for designing the distribution system concepts, and for determining reqirements in both the amphibious and nonamphibious mode. A diagram of the base regimental MCATF is shown in figure I-3. There are five basic distribution cells, each with an organic unit train. There is no mobile combat service support detachment (MCSSD), i.e., no large, MCATF level train. The tactical requirement for flexible operation of the maneuver elements preclude an organization with a large central unit train that would require escort and protection, and would provide a lucrative and vulnerable target

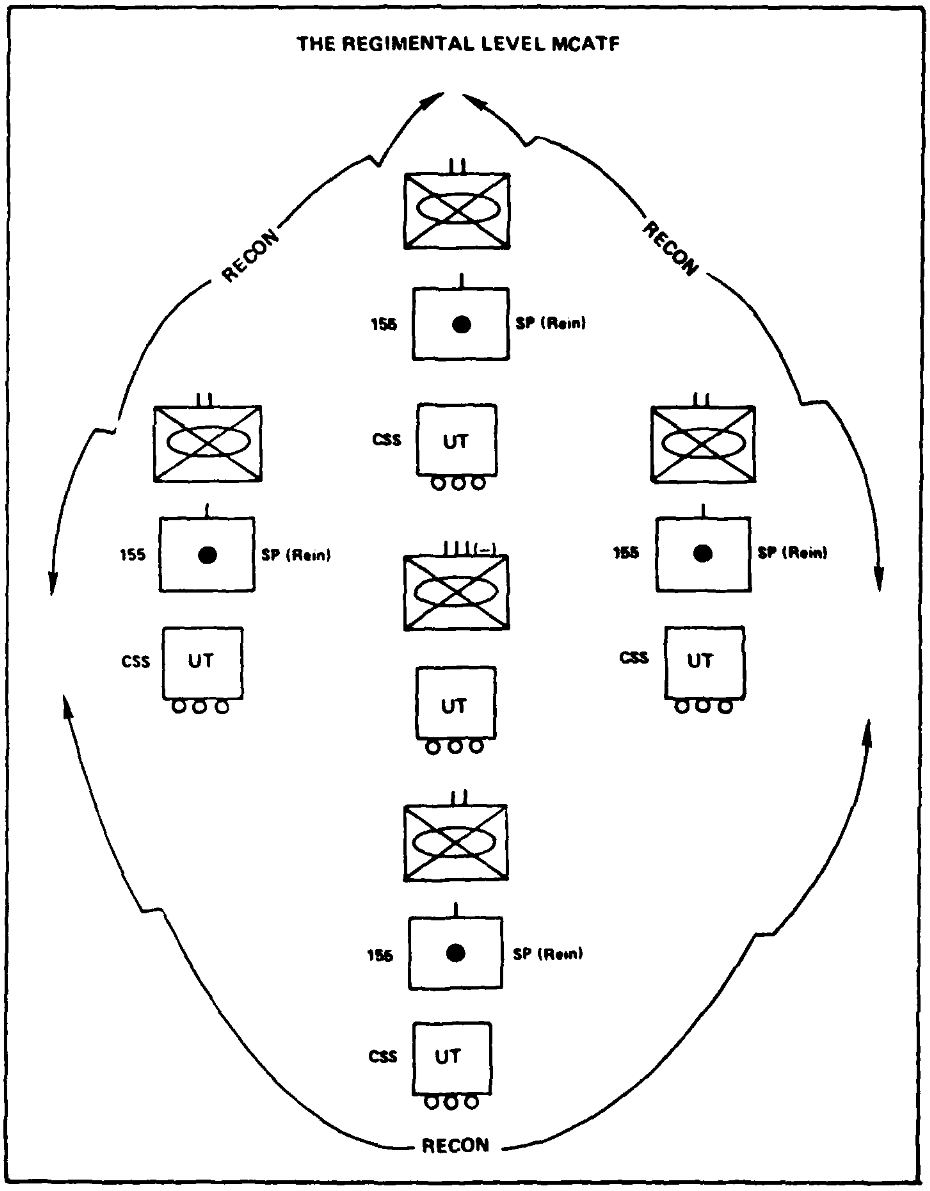


Figure I-3. Diagram of the Regimental Level MCATF

for enemy action. Smaller unit trains with each maneuver element provide both closer, more flexible response and smaller, less vulnerable target.

The size of the unit trains was severely restricted to retain the high combat ratio of effective maneuver elements. The design point for unit trains was taken to be one additional day of supply for the major weight/cube classes of supply (I, II, and V) as a base case. Individual mission variations would determine the actual proportion of supply classes, but the concept would be for each maneuver element to have a basic load in each vehicle, and an anticipated additional day-of-supply in its unit train.

To maintain the combat power and flexibility of these maneuver elements requires a resupply concept that is highly responsive and able to provide resupply to the unit trains whenever and wherever on the battlefield the maneuver element should require it. It is highly desirable that the transportation vehicle for resupply have a speed advantage over the maneuver element to be able to catch up to it without requiring it to stop. The highly maneuverable MCATF on a deep penetration mission should not have to protect and defend a ground line of communications (LOC) or a specific piece of terrain for a supply depot. The most reasonable concept for satisfying these requirements is to designate transport helicopters as the primary resupply vehicles, and to allow the MCATF to determine what, where, and when the resupply will be (demand-pull) rather than having the logistics support element determine what would be loaded, and where and when the resupply rendezvous would take place (supply-push).

In the long-range time frame, transport helicopters can be expected to have improved capabilities in terms of availability, efficiency, and all-weather, day-night operation. These capabilities make it possible for the concept to rely primarily on the essential need to maintain an uninterrupted aerial supply link to MCATFs using transport helicopters. This supply link imposes a maximum support distance which is considered to range somewhere between a 50 and 100 NM radius of operation, with 50 NM being a viable basis for current helicopter capability planning and the higher value approximating the radius of operations provided by the total internal fuel capability of current helicopters (e.g., 71 NM for the CH-46E, 80 NM for the CH-53E, and 104 NM, for the CH-53D). The range of these or future helicopter transports may be extended out to several hundred miles with reduced payloads. Nevertheless, a single-hop working radius of 75 NM was selected as representative of the design capability that would support the concept of helicopter transport of supplies direct to MCATF unit trains. Figure I-4 shows a general diagram of this concept employed to provide support to a regimental MCATF direct from amphibious shipping.

In situations where total helicopter lifted resupply direct from ships is not fully feasible (extreme weather, tactical situation, or helo sortie insufficiency), alternative resupply techniques are envisioned. These techniques are <u>situationally dependent</u>, and could include:

(1) Landing craft air cushion (LCAC) ship-to-shore (landing site); escorted convoy to unit trains.

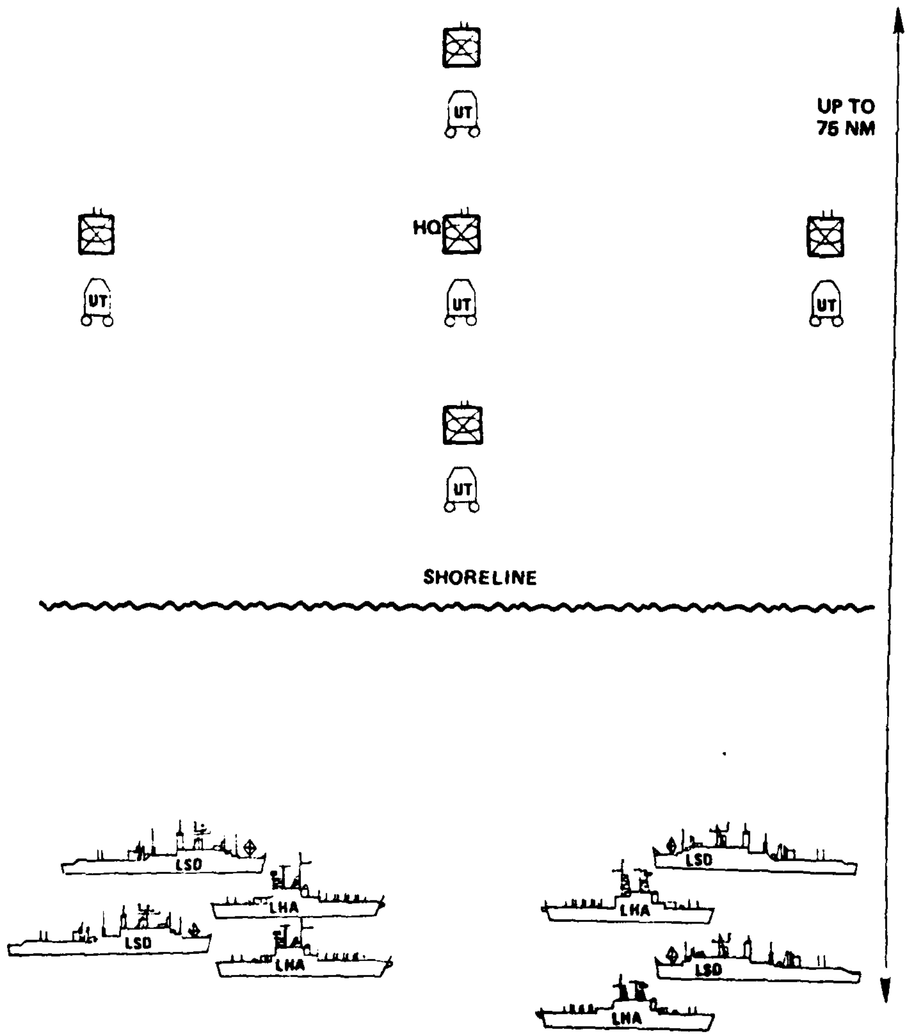


Figure I-4. Direct Ship-to-MCATF Support Concept

(2) LCAC ship-to-shore; dump as cache for later pickup by escorted or unescorted elements of unit trains.

(3) LCAC ship-to-shore rendezvous site to meet escorted or unescorted elements of units trains.

(4) Establishment of a BSA, including the associated security force and the protected ground or helicopter transportation resources required to deliver supplies to the unit trains of the MCATF maneuver elements. The BSA would be located in terrain (probably not on the beach) that is accessible by LCAC and defendable with minimum ground forces not associated with the MCATF.

Reliance on ground transportation to effect the resupply of a deep-penetrating MCATF is clearly less flexible and responsive than helicopter transportation because:

(1) The intervening threat may necessit`te a circuitous supply route and cross-country operation which reduces the speed of resupply transports to equal or less than the MCATF.

(2) Increased transit time for the same penetration distance makes the demand-pull projection of resupply requirements more difficult.

(3) Increased variability in transit time to overcome or avoid obstacles increases the MCATF requirement to seize, hold, and defend the rendezvous point, making MCATF operations more terrain oriented.

Using fixed-wing, non-VTOL, aircraft for resupply (either air-drop or air-landed) would be possible, but would generally:

(1) Not overcome the difficulties in establishing helicopter resupply,

(2) Be less efficient and more demanding of the MCATF to prepare and control the rendezvous point,

(3) Require more remote supply bases and longer communications links.

Based on these consideration a planning radius of operations of 75 NMs was selected as a representative figure for transport helicopter resupply of MCATF forces in this study. This radius reflects the challenge of a 50 percent increase in the current helicopter support planning distance while still acknowledging qualitative and quantitative constraints that will prevail into the long range period. <u>Advanced technology is not expected to significantly extend this supportability radius due to the interrelationships of aircraft speed, size, range, payload, and reaction times</u>. Actual distance would vary, of course, depending on the specific combination of helicopter and environment (high temperature and altitude vs cool sea level) applicable in a specific operation.

I-4-1-1. Self sufficiency

Selection of a unit train for the MCATF that carries one day-of-supply for the MCATF implies that self-sufficient operations (no resupply) will be of limited scope. If a MCATF can be expected to advance no more than 50 km per day, then a penetration distance of up to 25 NM over the ground would be a reasonable limit for self sustaining operations, no matter what the size of the MAGTF or the number of maneuver elements involved. For the usual heavy MCATF this means a 25 NM penetration from the shoreline or the secure area, though the total distance may vary if the insertion and extraction points are different.

The study team also examined the implications of the introduction of the Light Armored Assault Battalion (LAAB) represented by the Light Armored Vehicle (LAV) family development. This analytic excursion was to determine if introduction of the LAAB into Marine divisions would generate any unusual CSS implications or supply requirements. As this report is written, the Marine Corps organization and concept of employment for the LAAB is preliminary (not firm). Current literature indicates that the LAAB may be employed as a maneuver battalion in either RDJTF operations as part of a nonamphibious MPS brigade, or in amphibious forcible entry operations. The battalion could also be used in a combat support role. Assuming the trend toward combined arms prevails, the study group envisions that the battalion will evolve in the long range period as a maneuver element, primarily inserted and extracted by helicopter for relatively short (less than 36 hours) missions involving "hit and run" tactics. Therefore, it is believed that the appropriate supply support concept is self-sufficiency. The penetration distances for the LAAB (air and ground) could run up to 100 NM, or so, with helicopter insertion and extraction. There is no feasible concept for deeper penetration (150 NM or 300 NM) with self-sufficient operation that does not require much larger unit trains.

I-4-1-2. Single supply circuit

If the planned penetration mission will last longer than can be supported by the organic MCATF, helicopter resupply is the preferred concept for either amphibious or shore-based operations.

Single-circuit resupply in an amphibious operation would generally rely on sea-based support with unit distribution direct to MCATF unit trains by helicopter. It assumes that the Navy has sea control and limited air superiority; the antiship missile threat has been neutralized; and support ships will remain in the amphibious objective area (AOA). Although a supply push system could be used for some operations, a demand-pull system is normally required. This concept is the most responsive support concept that is feasible for landing force MCATFs employing a maneuver style of warfare ashore. There is no BSA envisioned and it is noted that this technique is consistent with the draft MLRP. This concept implies a major technological effort to facilitate the close coordination required in all ship-to-MCATF interfaces. It relies on highly responsive, selective unloading throughout the amphibious operation (vice transition to general unloading). It could involve new ship design; it must involve packaging loads, storage of loads onboard ship, selective and responsive inventory location and control through computers, selective and

responsive movement of loads to helo spots, expeditious "hook up/pick up," and expeditious transition handling at the MCATF unit trains. It must be viable in almost all weather conditions.

In situations in which the MCATF penetration mission is conducted from a relatively secure ("cantonment") area ashore, supplies could be moved ashore by general unloading procedures to one or more packaging transition points, and there prepared for helicopter delivery to unit trains. If the secure area is large enough and extends inland from the port/beach unloading area, a forward CSS area (CSSA) might need to be established to support deep penetrations.

These concepts are appropriate for support of one or more regimental MCATFs if sufficient support assets are available, or even for a battalion-sized MCATF if its sustained operation against a limited threat is warranted. Penetrations out to approximately 75 NM can be fully supported by helicopters, and some helicopters may have limited capability to provide support beyond that distance. The concept of a single supply circuit is not appropriate for much deeper (150 to 300 NM) penetrations.

I-4-1-3. Concatenate or centroidal-elliptical support

There is no need to establish a more complex supply system for penetration missions within range of a single supply circuit, but sustained penetrations beyond about 75 NM (depending on helicopter capabilities) would require moving a CSSA or an MCSSD out into the unsecure "no-man's-land" that the MCATF has penetrated (figure I-5). This MCSSD would become an attractive and vulnerable target for enemy action using maneuver warfare concepts.

However, in nonamphibious RDJTF operations wherein the total force includes three regimental MCATFs, deeper tactical projections appear possible using one of the MCATFs to provide necessary protection to the accompanying MCSSD. Assuming the operational area extends inland along a major corridor and that the threat becomes proportionately greater with distance penetrated, a concurrent centroidal-elliptical or concatenate support system could be used with MCSSDs protected by one or two regimental MCATFs. Figures I-6 and I-7 are illustrative of this concept. Therefore, a maximum projection of a force containing three regimental level MCATFs may be initially estimated to be approximately 225 NM from a secure cantonment area. It should be noted that independent Marine Corps projections of this depth are highly theoretical and situationally dependent. Such penetration involves unconstrained CSS and helicopter assets.

The concept of figure I-7 illustrates uniform concatenate loops, but loop length is situationally dependent on terrain, threat, and assets available. Under some circumstances this concept might support limited penetration out to 300 NM. Deep penetration is achieved only at a high price in terms of combat power and flexibility. As figure I-7 illustrates, 2/3 of the combat power of the MAGTF is restricted in mission and location by the need to protect the MCSSD. Only the deepest element is unconstrained and able to exploit its maneuver warfare capabilities. This requirement to reduce effective combat

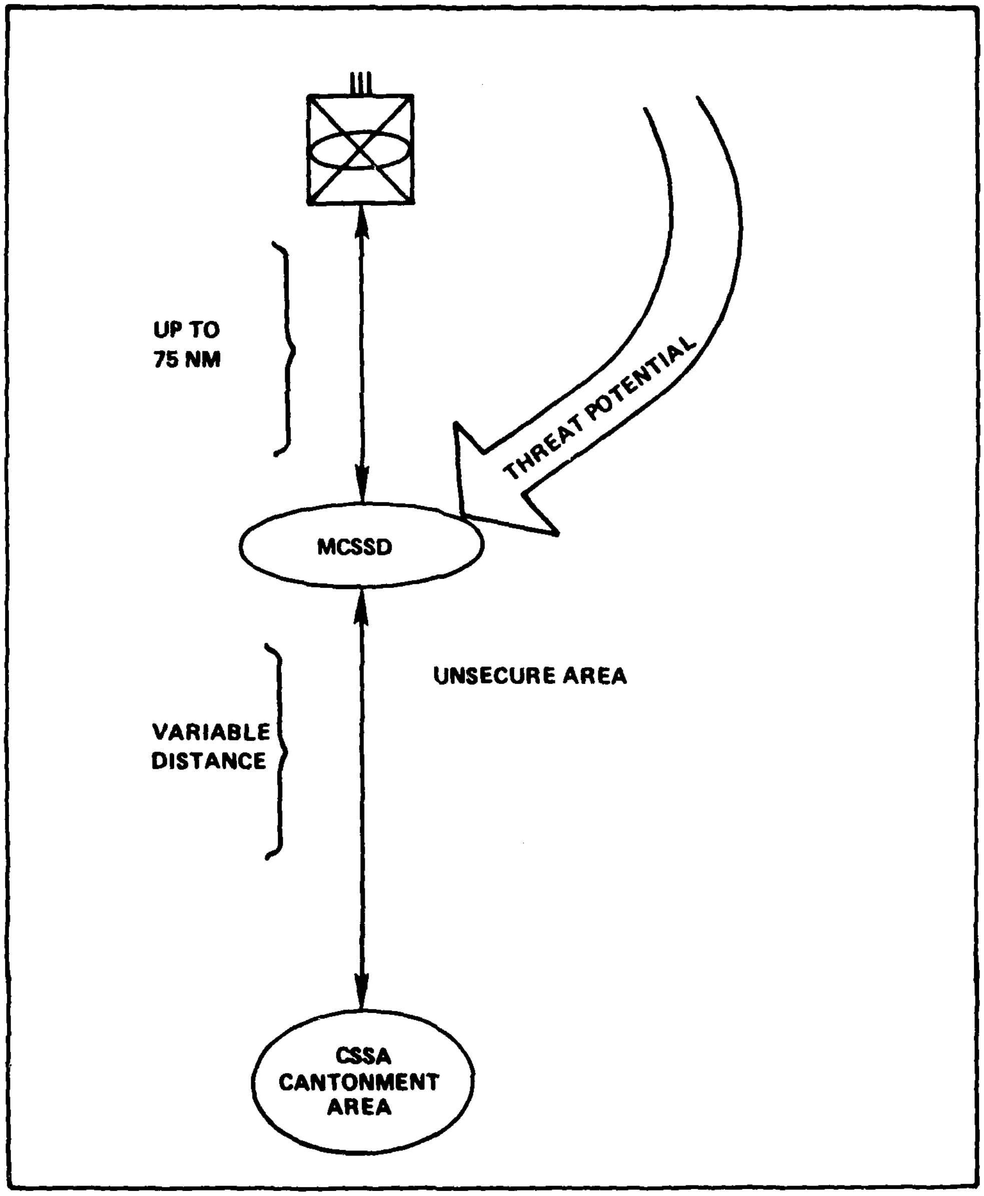


Figure I-5. Illustration of MCSSD Vulnerability

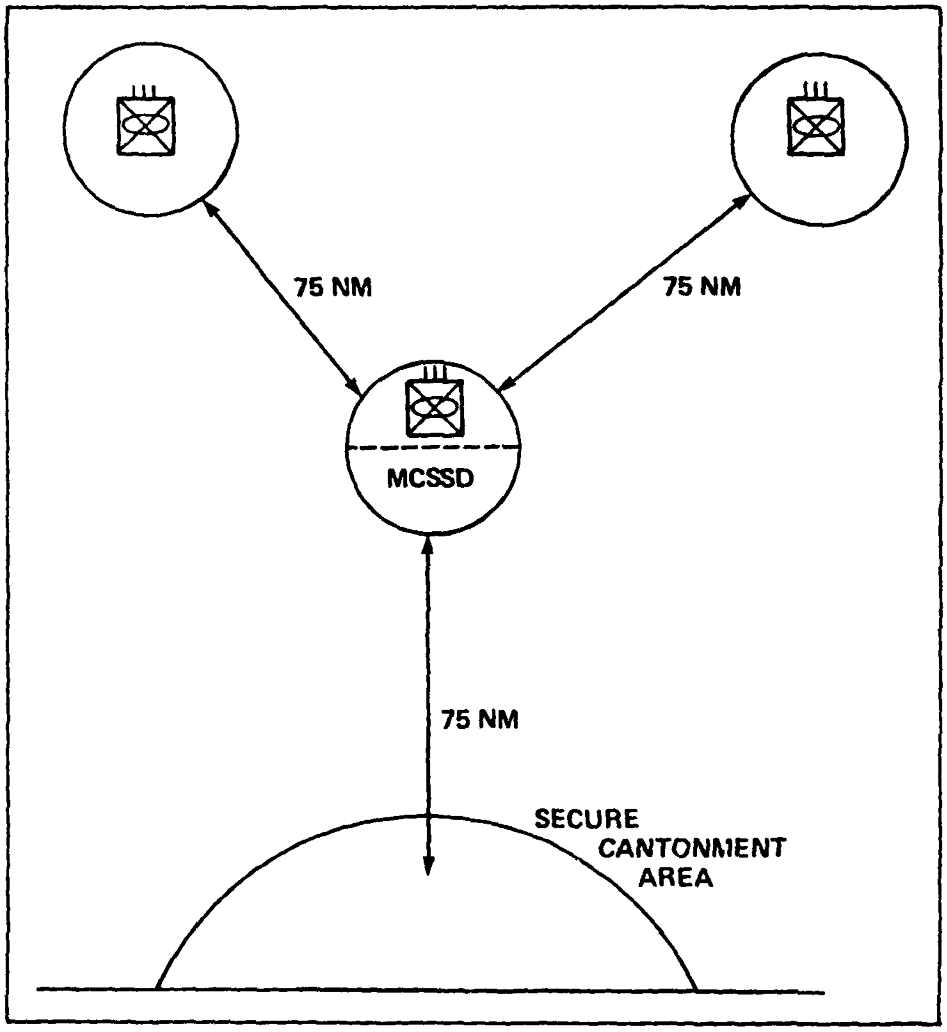


Figure I-6. Example of 150 NM Penetration

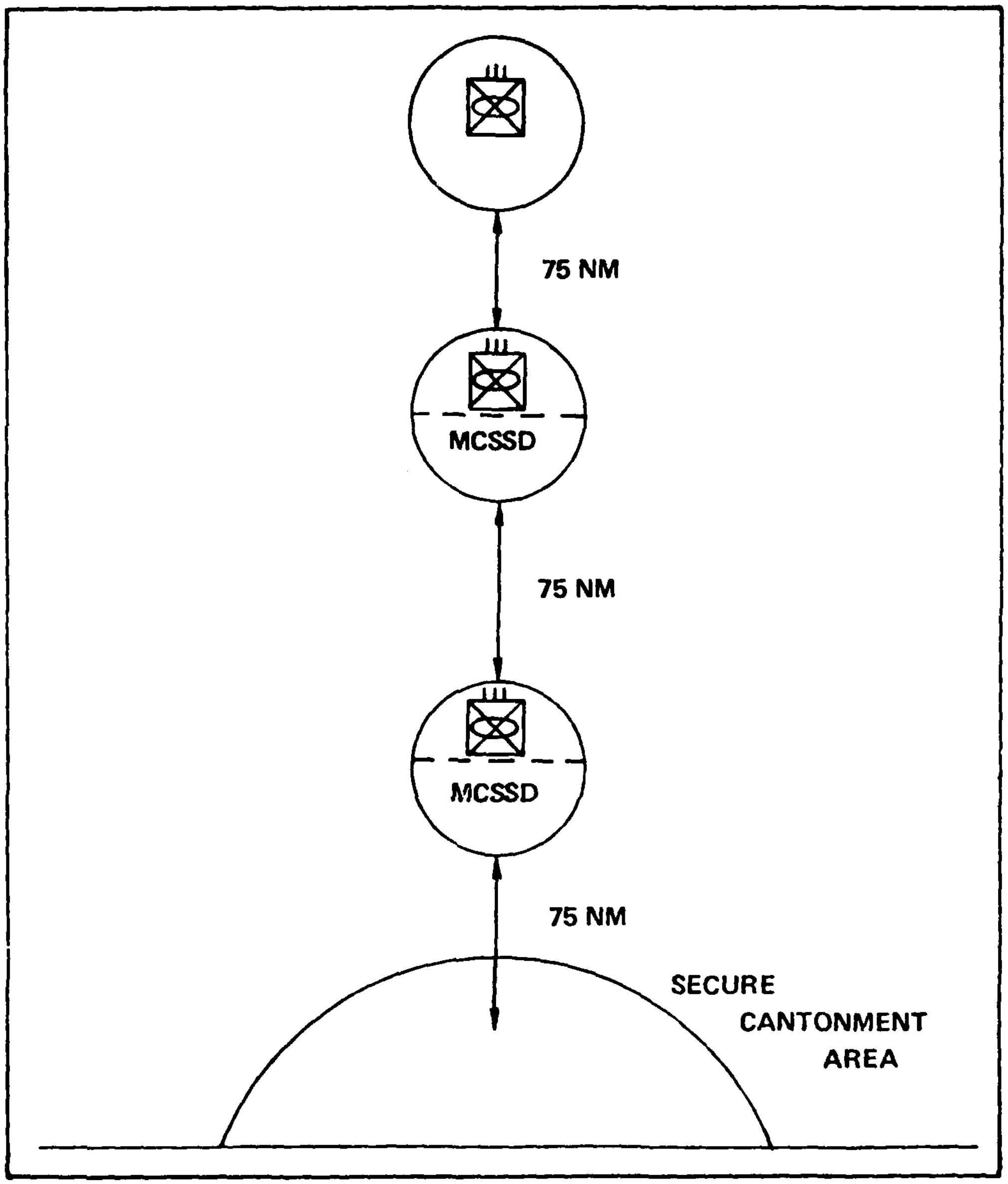


Figure I-7. Example of 225 NM Penetration

power makes it highly unlikely that regimental or battalion-sized MCATFs could, without heavy support, use these supply concepts to increase depth of penetration.

I-4-1-4. Air landed concept for deeper penetration

The study team reviewed and evaluated the overall concept of achieving extremely deep penetrations (300 NM or more) by means of fixed wing insertion (air assault) and support of the MCATF or fixed wing support by rendezvous with a deep penetrating MCATF. This concept was judged to be infeasible or inapplicable because:

(1) A joint Air Force/Marine Corps investigation of the air assault concept rejected the concept as too risky to execute against even a minimal threat.

(2) If a safe, secure airhead could be established and defended, it would, in the terms of this study, constitute a cantonment area from which penetration by a supported MCATF would be measured.

A summary of the applicable supply support concepts is depicted in table I-4.

Table I-4. Summary of Supply Support Concepts

TYPE ORGANIZATION	APPLICABLE SUPPORT CONCEPT: SELF SUFFICIENCY	SINGLE CIRCUIT	CENTROIDAL-ELLIPTICAL	CONCATENATE
BATTALION MCATF OR LAAB (LAV BN)	X	X		
REGIMENTAL MCATF	X	X		
THREE REGIMENTAL LEVEL MCATFs	X	X	X	X

I-4-1-5. Supply classes and concept amplification

The base regimental level MCATF will be used to provide amplification of the basic concepts and a description of the distribution system. The four maneuver elements and the MCATF headquarters element carry in their organic vehicles one day of Class I, one day of water, the prescribed load of Class V (which varies with weapon system and vehicle size), and the prescribed load of Class III (10 to 50 gallons in 5 gallon cans). The unit train for each of the four maneuver elements and the MCATF headquarters element carries one day of Class I, III, and V, a tailored allowance of critical spare parts (Class IX), and one day of water (normally 3 gallons per man). In addition, the unit trains of the MCATF headquarters element and one selected maneuver element will provide refueling/rearming capability for attack helicopters (i.e., one day of Class IIIA and Class VA for an helicopter attack (HMA) squadron). The tactical concept does not call for extensive barrier or other construction

with the MCATF. Class IV supplies will be minimal. Major end items that are helo transportable will be handled with other supplies on demand. Heavy vehicles and systems will usually not be resupplied during a deep penetration mission. Losses of these items to attrition and breakdown will reduce MCATF combat power and may well limit the duration of penetration missions. Delivery to the unit trains will be at selected times and locations depending on the tactical situation as applicable to the maneuver elements, aviation elements, and supporting logistic element. Coordination and assignment of priorities will be effected by the MCATF commander and his staff.

In addition to minimal size, unit trains should be:

- As mobile as the combat units so that tactical maneuver is not restricted.

- Adequately armed and armored (protected) so that diversion of combat power is not routinely required for unit train protection.

- Capable of receiving resupply and replenishing combat units rapidly with minimal impact on tactical operations.

The unit trains will be replenished from the sea bases, CSSA or cantonment area as applicable. Current estimates are that approximately a maximum of 1,029 tons of Class I, III, III(A), V, and V(A) replenishment supplies will be needed to provide for one day of representative consumption for the regimental MCATF, as detailed in paragraph I-5 below. It is noted that Class I requirements would essentially remain constant while the demand-pull for Classes III, III(A), V, and V(A) would vary significantly. When MCATF movement is greatest, Class III requirements would be high and Class V requirements low. Conversely, where there is a major engagement, Class V requirements would be high and Class III requirements low. Thus, the daily consumption of these classes would almost always have a wide variance.

Replenishment of the elements by the unit trains will probably take place during the period from late afternoon to early morning although it could take place at any time an urgent requirement exists. All Class I, III and V supplies, and water in 5-gallon containers are envisioned to be transported in unit trains on 22½-ton, 8x8 armored "dragon wagons," an articulated tractor-trailer unit with high mobility and survivability characteristics. Each dragon wagon would be equipped with an internal pump filter and hose unit for dispensing fuel and a hydraulic crane for handling cargo up to and including fuel modules. All supplies will be delivered to the unit trains in field logistic system (FLS) palcons, quadcons or sixcon fuel modules; 500 gallon collapsible drums; and MLRS pods. At a time and location, an appropriate number of dragon wagons transporting the required maneuver element supplies will take the supplies to the using organization for refueling and rearming the vehicles and dispensing rations and water, using a "filling station" concept. After replenishment the dragon wagons will return to the "trains' area." Quantities of supplies would be consolidated on the fewest number of vehicles, new replenishment requirements would be determined, and the additional quantities and types of supplies needed would be transmitted by the trains' logistic support commander to the logistic activity designated to coordinate control of the distribution.

I-4-2. Maintenance Support Concept

The maintenance support concept is primarily based on the following principles:

- Increased MAGTF use of an Operational Readiness Float (ORF) to reconstitute MCATF capabilities between major operations.

- Increased level of operator/crew maintenance and minor repair through "cross-training" and equipment design incorporating Built In Test (BIT)/Built-In Test Equipment (BITE).

- Increased design incorporating modular components facilitating replacement vice time consuming repair.

- Organizational level maintenance contact teams with high demand, critical Class IX items and applicable tools organic to unit trains.

- Intermediate level special contact teams in each major maintenance area available on-call at sea base, CSSA, or cantonment area, and helicopter lift of team direct to equipment casualty site when feasible.

- Vehicle casualties/failures are repaired or cannibalized/abandoned based on time-to-repair limits established by the MCATF and/or maneuver element commander(s) (mission situation dependent).

In amplification of the above principles, it is first noted that availability is greatly enhanced through increased MAGTF use of an operational readiness float (ORF) so that unserviceable major items of equipment are replaced by serviceable items between major MCATF missions. A direct exchange (DX) program for subassemblies or secondary items would operate in much the same manner, even during MCATF operations.

Although the trend in modern equipment is towards a higher degree of technical sophistication, there are mitigating factors as far as maintenance is concerned. BIT and BITE equipment enable an operator to determine the majority of faults. Equipment designed and engineered with modular components provides for replacement of faulty modules without time-consuming repair. A greater portion of these replacements will be accomplished by operators using "on-board" spare modules whose criticality and demand has been determined by advanced technology in demand forecasting.

In those instances when the operator cannot repair the equipment, the status of the equipment and the diagnostic fault will be relayed to the unit train maintenance coordinator. The maintenance unit in the unit train will have mechanics and technicians in the major fields of maintenance, the necessary special tools and equipment for most intermediate maintenance requirements, and an allowance configured to the equipment to be supported. In addition, the unit train will have a minimum of one recovery vehicle and the capability to perform minor battle damage repair on vehicles.

When unit train maintenance personnel are unable to make the necessary repairs, the requirement for maintenance assistance will be relayed to the CSS maintenance base ashore or afloat. Data forwarded to the CSS base will include information on the type of equipment, fault diagnosis and repair parts, tools and equipment needed, and estimated time to repair. On small major items such as radios, unit replacement of the unserviceable item will be made where possible. A determination will be made at the CSS base regarding item replacement, repair parts, tools and equipment and personnel skills required. Maintenance contact team in the major maintenance areas (electronics, automotive, tracked vehicles, artillery, turret, etc.) have been formed and are on-call. The contact team with the required parts would be dispatched by helicopter to perform the repairs. Depending upon requirements, the contact team may give assistance to more than one maneuver element on one trip.

In a fluid, rapidly moving MCATF environment, the tactical situation will often dictate that sufficient time is not available to repair major items of equipment. Predetermined time-to-repair parameters will be established to facilitate the determination. Before abandoning or destroying equipment, it will normally be cannibalized for required parts and rendered useless to the enemy.

I-4-3. <u>Engineer Support Concept</u>

Major bridging capability would be a centralized asset at the engineer battalion level; pre-constructed bridge sections maintained afloat or in a cantonment area, helicopter lifted and helicopter emplaced. This type of bridging would <u>not</u> be required in the vast majority of MCATF operations.

Employment or reduction of extensive fixed barrier systems is not envisioned; mine laying by engineers is envisioned as a supplementary rather than a primary task.

Sea basing implies containerized bulk fuel transfer ship-to-shore in the amphibious mode. In the nonamphibious mode, extensive horizontal and vertical construction and bulk fuel handling are confined to a cantonment area or to one (or more) forward, secure CSSAs in conjunction with a cantonment area.

I-4-4. <u>Landing Support Operations Concept</u>

The concepts for MCATF operation do not normally rely on BSAs. Beach operations in amphibious assaults would be limited to those special situations requiring temporary BSAs or the stockage of caches.

Each of the maneuver units of the penetrating MCATFs, and the MCSSD where required, will depend heavily on the operation of Helicopter Support Teams (HST) to support resupply of each unit train. Normal landing support operations tasks of LZ control, container control, and supply transfer will be accomplished with each unit train.

I-4-5. <u>Medical/Dental Support Concept</u>

Medical support for MCATFs in penetration missions will be limited by the requirement to maintain mobility. The normal battalion aid station (BAS)

treatment will be restricted in order to expedite evacuation of patients that may require even short-term confinement. Helicopter medical evacuation offers the only reliable technique for transporting patients across the intervening no-man's-land. The BAS would accompany the unit train and evacuate patients direct to the secure areas, if possible, or to the supporting MCSSD. An MCSSD may have the equivalent of an evacuation station to tranship or temporarily treat patients if direct helicopter evacuation to the rear is not possible. Medical company facilities will remain onboard ship or in the secure cantonment area.

I-4-6. Materials Handling Equipment Concept

Materials handling will be performed at the packaging transition points which are onboard ship, in the port or CSSA of a cantonment, in the MCSSD, and at the unit trains. Handling equipment at the unit trains will be associated with the supply vehicles (e.g., dragon wagons, ammo vehicles, helicopters). Normal equipment would be used in a port or CSSA. There may be a requirement for new equipment to handle supply packaging onboard ship for direct deliver to unit trains. Transhipment at MCSSDs will be held to a minimum, but there still might be a requirement for highly mobile materials handling equipment.

I-4-7. Food Service Concept

The MCATF tactical concept envisions highly flexible movement by each maneuver element. Meals must be provided through the unit trains to each maneuver element independently. In normal circumstances, troops on a penetration mission of limited duration will be provided only combat rations.

I-4-8. Military Police Support Concept

Most of the military police (MP) subfunctions and tasks are related to rear areas security and movement control. Neither of these is appropriate to MCATF penetration missions. MP MCATF support will still involve POW escort to confinement in secure areas, but security within the maneuver elements will be the responsibility of the tactical commander.

I-5. QUANTITATIVE ANALYSIS OF REQUIREMENTS

Supply support requirements were determined for three basic tactical configurations: (1) the base regimental MCATF containing four maneuver elements, (2) the three regimental level MCATFs formed from the resources of two Marine Divisions, and (3) the LAAB or LAV battalion. In addition, requirements were determined for a representative CSSA, and a representative MCSSD.

I-5-1. The Base Regimental MCATF

Table I-5 depicts the organization of the regimental MCATF, its major weapons systems, vehicles and unit trains. The number of logistic vehicles (dragon wagons) in the unit trains were calculated to carry one day of supply. Table I-6 depicts the requirements in tonnage by class. Water was calculated at three gallons per man per day. It is emphasized that Class I is the only constant demand--distribution of other classes will vary daily in the demand-pull system. Table I-7 summarizes the logistic vehicle requirements by class. Table I-8 provides a comparison of the total vehicles in the unit trains to

Table I-5. Long Range Regimental MCATF

	PERS	LVTX-P	LVTX-C	LVTX-E	LAV	LAV (C)	AVLB	155 P	AMMO VEH	MLRS	TANK	LAV (AD)	MG 5.56	MG 7.62	25mm	MG 50 cal	TOW	STINGER	81mm
ME-A																			
H/S Co, Inf Bn	142	4	2										8	4	4		1		
Wpns Co	61	8											16	8	8		1		8
Rifle COs (3)	360	27											54	27	27		6		
Arty Btry 155(SP)	93	3						8	8	3			6	3	3	16			
Arty FO Tm	12																		
Tank Co	64	1									14		2	15	1	14			
Engr Plt	41			6			1												
FAAD Det	13	2											4	2	2			6	
AAV Co(-)	139																		
	925	45	2	6			1	8	8	3	14		90	59	45	30	8	6	8
ME-B																			
H/S Co, Inf Bn	142	4	2										8	4	4		1		
Wpns Co	61	8											16	8	8		1		8
Rifle COs (3)	360	27											54	27	27		6		
Arty Btry 155(SP)	93	3						8	8	3			6	3	3	16			
Arty FO Tm	12																		
Tank Co	64	1									14		2	15	1	14			
Engr Plt	41			6			1												
FAAD	13	2											4	2	2			6	
AAV Co(-)	139																		
	925	45	2	6			1	8	8	3	14		90	59	45	30	8	6	8
ME-C																			
H/S Co, Tk Bn	84	3	2										6	3	3		1		
Tank COs (2)	128	2									28		4	30	2	28			
Rifle COs (2)	240	18											36	18	18		4		
Arty Btry 155(SP)	93	3						8	8	3			6	3	3	16			
Arty FO Tm	8																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2	2			6	
AAV Co(-)	88																		
	695	28	2	6			1	8	8	3	28		66	56	28	44	5	6	
ME-D																			
H/S Co, Inf Bn	142	4	2										8	4	4		1		
Wpns Co	61	8											16	8	8		1		8
Rifle COs (4)	480	36											72	36	36		8		
Arty Btry 155(SP)	93	3						8	8	3			6	3	3	16			
Arty FO Tm	16																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2	2			6	
AAV Co(-)	154																		
	1,010	53	2	6			1	8	8	3			104	53	53	16	10	6	8
MCATF Hq																			
Hq Co	104	9	4										18	9	9		2		
Tank Bn Det	2																		
Arty Bn Det	5																		
Engr Co Hq	4																		
FAAD Det	14	2											4	2	2			6	
Arty Hq Btry	97	8	2										16	8	8				
Targ Acq	21																		
MRL Bty Hq	8																		
Tank Co	64	1									14		2	15	1	14			
MAD Plt	38											6							
Recon Co	105				16	5								16	16				
Div Recon Co	105				16	5								16	16				
AA Bn Det	5																		
AAV Co(-)	72																		
	644	20	6		32	10					14	6	40	66	52	14	2	6	
	4,199	191	14	24	32	10	4	32	32	12	70	6	382	293	223	134	33	30	24

Unit Trains	PERS	LVTX-P	LVTX-R	LVTX-C	M-578	M-88	40W
MCSSU							
HST	54	1					16
H/S Co	9			1			
Bn Aid	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
Tanks	13	1				1	
AAV Det	34	1	1				
	143	7	1	1	1	1	16
MCSSU							
HST	54	1					16
H/S Co	9			1			
Bn Aid	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
Tanks	13	1				1	
AAV Det	34	1	1				
	143	7	1	1	1	1	16
MCSSU							
HST	52	1					16
H/S Co	9			1			
Bn Aid	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1					
AAV Det	34	1	1			2	
	158	7	1	1	1	2	16
MCSSU							
HST	50	2					14
H/S Co	9			1			
Bn Aid	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
AAV Det	34	1	1				
	126	7	1	1	1		14
MCSSU							
HST	62	2		1			
Hq Co	9	1					
Tank Co	13	1				1	11
MAD	2						
Recon	1						
Div Recon	1						
FAAD	1						
MCATFAID	8	2					
Hq Btry	13	1					
AAV Det	31	1	1				
	141	8	1	1		1	11
	711	36	5	5	4	5	73

LVTX-P--Landing vehicle tracked, experimental personnel carrier

LVTX-C--LVTX, command/communication

LVTX-E--LVTX, engineer

LVTX-R--LVTX, recovery

LAV--Light armored vehicle

LAV(C)--LAV, command/communication

LAV(AD)--LAV, air defense

AVLB--Armored vehicle launched bridge

M-578--Recovery vehicle, full tracked, light, armored

M-88--Recovery vehicle, full tracked

Table I-6. Long Range Regimental MCATF; Tonnage Requirements for One Day of Supply

Maneuver Elements	Cl I (3 gal H_2O/man)	Cl III	Cl IIIA	Cl V	Cl VA	Total
A	17.7	36.5		170		224.2
B	17.7	36.5		170		224.2
C	14.3	39.1		170		223.4
D	18.7	30.6		163		212.3
Hq	13.2	30.7	36.7	26.9	37.4	144.9
Total	81.6	173.4	36.7	699.9	37.4	1,029.0

Table I-7. Long Range Logistic Vehicle Requirements

Elements	Cl I	Cl III	Cl IIIA	Cl V	Cl VA	Total
A	1	3		12		16
B	1	3		12		16
C	1	3		12		16
D	1	2		11		14
Hq	1	2	3	2	3	11
Total	5	13	3	49	3	73

(For 6 gal water/man/day, 1 additional log veh is required in each maneuver element.)

Table I-8. Comparison of Unit Train Vehicles to Total Vehicles

Elements	Total Vehicles	Unit Train Vehicles	Unit Train Vehicles; Percent of Total
A	114	27	23.7
B	114	27	23.7
C	112	28	25.0
D	105	24	22.9
Hq	110	22	20.0
Total MCATF	555	128	23.1

the total vehicles in the MCATF. These percentages are considered to be very favorable "tooth-to-tail" ratios. CH-53E helicopter requirements to support distribution of one day of supply to the unit trains are shown in Table I-9.

Table I-9. Long Range Helicopter Support Requirements; Regimental Level MCATF

Total Lift Required	Ave. Lift, 75 NM Radius	CH-53E Sorties Per Day	Flight Hrs per Sortie	Total Flight Hrs per Day	Aircraft Flt hrs per Day	Aircraft per Day
1,029 T	12 T	86	1.8	155	3	52

I-5-2. The Three Regimental MCATFs. Table I-10 depicts the detailed organization of the three regimental level MCATFs. Again, the number of logistic vehicles in the unit trains were calculated to carry one day of supply.

Table I-10. Notional Organization of Three Regimental MCATFs

TASK FORCE ALPHA

UNIT	PERS	LVTX-P	LVTX-C	LVTX-E	LAV	LAV (C)	AVLB	155SP	AMMO VEH	MLRS	TANK	LAV (AD)	MG 5.56	MG 7.62	MG 50 cal	25mm	TOW	STINGER	81mm
1st Tank Bn																			
H/S Co Tk Bn	84	5	2										10	5		5	1		
Tank Co (2)	128	2									28		4	30	28	2			
Rifle Co (2)	240	18											36	18		18	4		
155(SP) Btry	93	3						8	8	3			6	3	16	3			
Arty FO Tm	8																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2		2		6	
AAV Det	94																		
	701	30	2	6			1	8	8	3	28		60	53	44	30	5	6	
2nd Tank Bn																			
H/S Co Tk Bn	84	5	2										10	5		5	1		
Tank Co (2)	128	2									28		4	30	28	2			
Rifle Co (2)	240	18											36	18		18	4		
155(SP) Btry	93	3						8	8	3			6	3	16	3			
Arty FO Tm	8																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2		2		6	
AAV Det	94																		
	701	30	2	6			1	8	8	3	28		60	59	44	30	5	6	
3rd Bn 6th Mar																			
H/S Co Inf Bn	142	6	2										12	6		6	1		
Wpns Co	61	8											16	8		8	1		8
Rifle Co (4)	480	36											72	36		36	8		
155(SP) Btry	93	3						8	8	3			6	3	16	3			
Arty FO Tm	16																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2		2		6	
AAV Det	170																		
	1,016	55	2	6			1	8	8	3			110	55	16	55	10	6	8
Hq Task Force ALFA																			
Hq Co	104	9	4										8	4		4	2		
Tank Bn Det	2																		
Arty Bn Det	5																		
Engr Co Hq	4																		
FAAD Det	14	2											4	2		2		6	
Arty Hq Btry	97	8	2										16	8		8			
Targ Acq Det	21																		
MLR Btry Hq	8																		
MAD Plt	38											6							
Recon Co	105				16	5								16		16			
Div Recon Co	105				16	5								16		16			
AAV Bn Det	5																		
AAV Det	70																		
	578	19	6		32	10						6	28	46		46	2	6	
	2,996	134	12	18	32	10	3	24	24	9	56	6	253	217	104	161	22	24	8

UNIT TRAIN	PERS	LVTX-P	LVTX-R	LVTX-C	M-578	M-88	ADW
MCSSU							
HST	52	1					16
H/S Co	9			1			
Bn AID	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1				2	
AAV	37	1	1				
	159	7	1	1	1	2	16
MCSSU							
HST	52	1					16
H/S Co	9			1			
Bn AID	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1				2	
AAV	37	1	1				
	159	7	1	1	1	2	16
MCSSU							
HST	50	2					15
H/S Co	9			1			
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
AAV	37	1	1				
	129	7	1	1	1		15
MCSSU							
HST	56	2					10
Hq Co	9	1		1			
MAD	12						
Recon Co	1						
Div Recon	1						
FAAD	1						
MCATF-AID	8	2					
Hq Btry	13	1					
AAV	39	1	1				
	140	7	1	1			10
	587	28	4	4	3	4	57

Table I-10. Notional Organization of Three Regimental MCATFs (Cont'd)

5TH MARINES MCATF

UNIT	PERS	LVTX-P	LVTX-C	LVTX-E	LAV	LAV (C)	AVLB	155SP	AMMO VEH	MLRS	TANK	LAV (AD)	MG 5.56	MG 7.62	MG 50 cal	25mm	TOW	STINGER	81mm	UNIT TRAIN	PERS	LVTX-P	LVTX-R	LVTX-C	M-578	M-88	ADW
1st Bn 5th Mar																				MCSSU							
H/S Co Inf Bn	142	6	2										12	6		6	1			HST	54	1					16
Wpns Co	61	8											16	8		8	1		8	H/S Co	9			1			
Rifle Co (3)	360	27											54	27		27	6			Bn AID	20	4					
155(SP) Btry	93	3						8	8	3			6	3	16	3				Arty	11				1		
Arty FO Tm	12																			Engr	1						
Tank Co	64	1									14		2	15	14	1				FAAD	1						
Engr Plt	41			6			1													TANKS	13	1				1	
FAAD Det	13	2											4	2		2		6		AAV	37	1	1				
AAV Det	145																										
TOTAL	931	47	2	6			1	8	8	3	14		94	61	30	47	8	6	8		146	7	1	1	1	1	16
2nd Bn 5th Mar																				MCSSU							
H/S Co Inf Bn	142	6	2										12	6		5	1			HST	54	1					16
Wpns Co	61	8											16	8		8	1		8	H/S Co	9			1			
Rifle Co (3)	360	27											54	27		27	6			Bn AID	20	4					
155(SP) Btry	93	3						8	8	3			6		16	3				Arty	11				1		
Arty FO Tm	12																			Engr	1						
Tank Co	64	1									14		2	15	14	1				FAAD	1						
Engr Plt	41			6			1													Tanks	13	1				1	
FAAD Det	13	2											4	2		2		6		AAV	37	1	1				
AAV Det	145																										
TOTAL	931	47	2	6			1	8	8	3	14		94	61	30	47	8	6	6		146	7	1	1	1	1	16
3rd Bn 5th Mar																				MCSSU							
H/S Co Inf Bn	142	6	2										12	6		6	1			HST	54	1					16
Wpns Co	61	8											16	8		8	1		8	H/S Co	9			1			
Rifle Co (3)	360	27											54	27		27	6			Bn AID	20	4					
155(SP) Btry	93	3						8	8	3			6	3	16	3				Arty	11				1		
Arty FO Tm	12																			Engr	1						
Tank Co	64	1									14		2	15	14	1				FAAD	1						
Engr Plt	41			6			1													Tanks	13	1				1	
FAAD Det	13	2											4	2		2		6		AAV	37	1	1				
AAV Det	145																										
TOTAL	931	47	2	6			1	8	8	3	14		94	61	30	47	8	6	8		146	7	1	1	1	1	16
HQ 5th Mar-MCATF																				MCSSU							
Hq Co	104	9	4										18	9		9	2			HST	56	2					11
Tank Bn Det	2																			Hq Co	9	1		1			
Arty Bn Det	5																			MAD	2						
Engr Co Hq	4																			Recon	1						
FAAD Det	14	2											4	2		2		6		Div Recon	1						
Arty Hq Btry	97	8	2										16	8		8				FAAD	1						
Targ Acq Det	21																			MCATF-AID	8	2					
MLR Btry Hq	8																			Hq Btry	13	1					
MAD Plt	38											6								AAV	39	1	1				
Recon Co	105				16	5								16		16				Tank Co	13	1				1	
Div Recon Co	105				16	5								16		16											
AAV Bn Det	5																										
AAV Det	72																										
Tank Co	64	1									14		2	15	14	1											
TOTAL	644	20	6		32	10					14	5	40	66	14	52	2	6			143	8	1	1		1	11
	3,437	161	12	18	32	10	3	24	24	9	56	6	322	249	104	193	26	24	24		581	29	4	4	3	4	59

Table I-10. Notional Organization of Three Regimental MCATFs (Cont'd)

6TH MARINES MCATF

UNIT	PERS	LVTX-P	LVTX-C	LVTX-E	LAV	LAV (C)	AVLB	155SP	AMMO VEH	MLRS	TANK	LAV (AD)	MG 5.56	MG 7.62	MG 50 cal	25mm	TOW	STINGER	81mm
1st Bn 6th Mar																			
H/S Co Inf Bn	142	6	2										12	6		6	1		
Wpns Co	61	8											16	8		8	1		8
Rifle Co (3)	360	27											54	27		27	6		
155(SP) Btry	93	3						8	8	3			6	3	16	3			
Arty FO Tm	12																		
Tank Co	64	1									14		2	15	14	1			
Engr Plt	41			6			1												
FAAD Det	13	2											4	2		2		6	
AAV Det	145																		
TOTAL	931	47	2	6			1	8	8	3	14		94	61	30	47	8	6	8
2nd Bn 6th Mar																			
H/S Co Inf Bn	142	[illegible]	2										12	6		6	1		
Wpns Co	61	8											16	8		8	1		8
Rifle Co (4)	480	36											72	36		36	8		
155(SP) Btry	93	3						8	8	3			6	3	16	3			
Arty FO Tm	16																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2		2		6	
AAV Det	170																		
TOTAL	1,016	55	2	6			1	8	8	3			110	55	16	57	10	6	8
Hq 6th Mar MCATF																			
Hq Co	104	9	4										18	9		9	2		
Tank Bn Det	2																		
Arty Bn Det	5																		
Engr Co Hq	4																		
FAAD Det	14	2											4	2		2		6	
Arty Hq Btry	97	8	2										16	8		8			
Targ Acq Det	21																		
MLR Btry Hq	8																		
MAD Plt	38											6							
Recon Co	105				16	5								16		16			
Div Recon Co	105				16	5								16		16			
AAV Bn Det	5																		
AAV Det	72																		
Tank Co	64	1									14		2	15	14	1			
TOTAL	644	20	6		32	10					14	6	40	66	14	52	2	6	
	2,591	122	10	12	32	10	2	16	16	6	28	6	244	182	60	157	20	18	16

UNIT TRAIN	PERS	LVTX-P	LVTX-R	LVTX-C	M-578	M-88	ADW
MCSSU							
HST	54	1					16
H/S Co	9			1			
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
Tank	13	1				1	
AAV	37	1	1				
	146	7	1	1	1	1	16
MCSSU							
HST	50	2					15
H/S Co	9			1			
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
AAV	37	1	1				
	129	7	1	1	1		15
MCSSU							
HST	56	2					12
Hq Co	9	1		1			
MAD	2						
Recon	1						
Div Recon	1						
FAAD	1						
MCATF-AID	8	2					
Hq Btry	13	1					
AAV	39	1	1				
Tank Co	13	1				1	
	143	8	1	1		1	12
	418	22	3	3	2	2	43

LVTX-P--Landing vehicle tracked, experimental personnel carrier

LVTX-C--LVTX, command/communication

LVTX-E--LVTX, engineer

LVTX-R--LVTX, recovery

LAV--Light armored vehicle

LAV(C)--LAV, command/communication

LAV(AD)--LAV, air defense

AVLB--Armored vehicle launched bridge

M-578--Recovery vehicle, full tracked, light, armored

M-88--Recovery vehicle, full tracked

Table I-11 depicts the requirements in tonnage with water again calculated at three gallons per man per day. Table I-12 summarizes the logistic vehicle requirements by class; table I-13 provides a comparison of the vehicles in the unit trains to the total vehicles in the MCATFs. CH-53E helicopter support requirements are shown in table I-14.

1-5-3. The Light Armored Assault Battalion.

Figure I-8 depicts the preliminary organization of the LAAB or LAV battalion and Table I-15 summarizes the personnel and vehicles, by type. Note that the logistic vehicles are inherent to the battalion structure. Due to the probability of tactical insertion and extraction of the battalion by helicopter, no augmentation of the unit train with non-helicopter transportable vehicles is possible. Table I-16 shows the supply support requirements by class in tonnage for one day of supply. The total of 81.9 tons exceeds the estimated capacity of the 16 LAV(L) vehicles by 17.9 tons. However, it may be assumed that all of the Class I has been issued and that there is no requirement to carry additional Class I in the logistic vehicles due to the estimated short duration of battalion operational missions. In addition, there would normally be no need to carry a full day of Class III in the LAV(L) vehicles. Therefore, the first priority is to ensure that a full day of Class V is available in the organic unit train. It requires 11 of the 16 vehicles to carry the 42.3 tons of Class V. This leaves 5 vehicles to carry Class III and IX. It is estimated that at least one LAV(L) would be used to carry Class IX in addition to Class IX that would be carried in the two LAV(R) vehicles. This means that up to four vehicles could be used as refuelers, carrying 2,000 gallons of Class III.

It should be noted that the evolution of the LAV development into the long range period portends many significant changes to the battalion organization.

I-5-4. A Representative Forward CSSA.

The requirements to establish and operate a forward CSSA to support the base case regimental MCATF operating up to 75 NM out from the CSSA were based on a five day level of supply for the MCATF and a refuel/rearm facility for supporting aviation elements. A diagram of the representative CSSA is shown in figure I-9. Table I-17 depicts the five day level of supply, by class, and includes the personnel needed to operate the CSSA. Table I-18 shows the estimated personnel and equipment required to operate the CSSA. It is noted that contemporary equipment and known related personnel were used rather than conceptual equipment which might require fewer personnel. It is believed an accurate estimate of this type would be a preferred point-of-depature for future investigation of a CSSA in the long range period. The estimated engineer/construction effort to establish the CSSA is summarized in table I-19.

Table I-11. Three Regimental MCATFs One Day Tonnage Requirements

MCATF	CL I	Cl III	Cl III(A)	Cl V	Cl V(A)	Total
TF-ALPHA	59.6	132.7	36.7	523.8	37.4	790.2
5th Marines	66.6	142.3	36.7	537.9	37.4	820.9
6th Marines	49.8	99.8	36.7	362.3	37.4	586.0
Totals	176.0	374.8	110.1	1,424.0	112.2	2,197.1

Table I-12. Three Regimental Level MCATFs; Summary of Supply Vehicle Requirements

MCATF	Cl I	Cl III	Cl III(A)	Cl V	Cl V(A)	Totals
TF-ALPHA	4	11	3	36	3	57
5th Marines	4	12	3	37	3	59
6th Marines	3	9	3	25	3	43
Totals	11	32	9	98	9	159

Table I-13. Comparison of Unit Train Vehicles to Total Vehicles

MCATF	Total Vehicles	Unit Train	Unit Train Percent of Total
TF-ALPHA	428	100	23.4
5th Marines	458	103	22.5
6th Marines	330	75	22.7
Totals	1,216	278	22.9

Table I-14. Long Range Helicopter Support Requirements; Three Regimental Level MCATFs

Total Lift Required	Ave. Lift, 75 NM Radius	Sorties Per Day	Flight Hrs per Sortie	Total Flight Hrs per Day	Aircraft Flt hrs per Day	Aircraft per Day
2,197.1T	12T	184	1.8	331.2	3	111

Figure I-8. Light Armored Assault Battalion Planning Structure

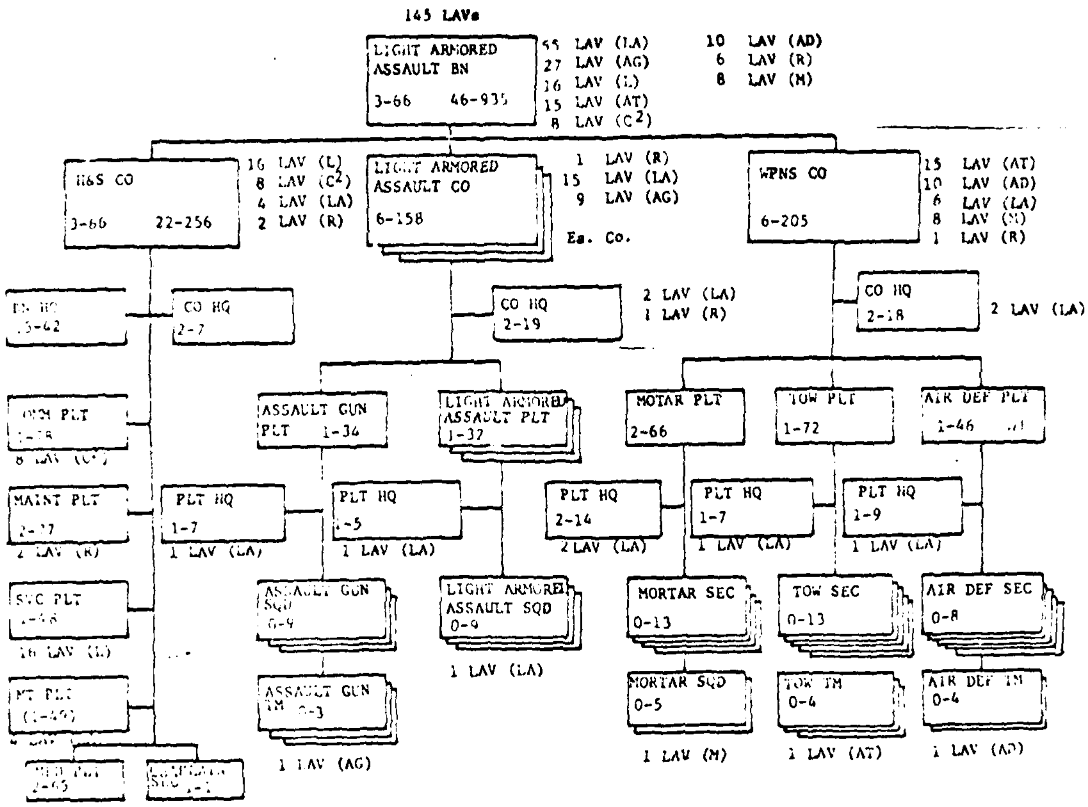


Table I-15. Light Armored Assault Battalion, Vehicle Summary

Unit	Pers	LAV(LA)	LAV(GA)	LAV(AT)	LAV(C^2)	LAV(AD)	LAV(M)	LAV(A)	LAV(L)
H&S Co	130	4			8			2	16
Wpns Co	211	6		15		10	8	1	
A Co (LAA)	164	15	9					1	
B Co (LAA)	164	15	9					1	
C Co (LAA)	164	15	9					1	
	833	55	27	15	8	10	8	6	16

Table I-16. Light Armored Assault Battalion
One Day of Class I, III and V Tonnage

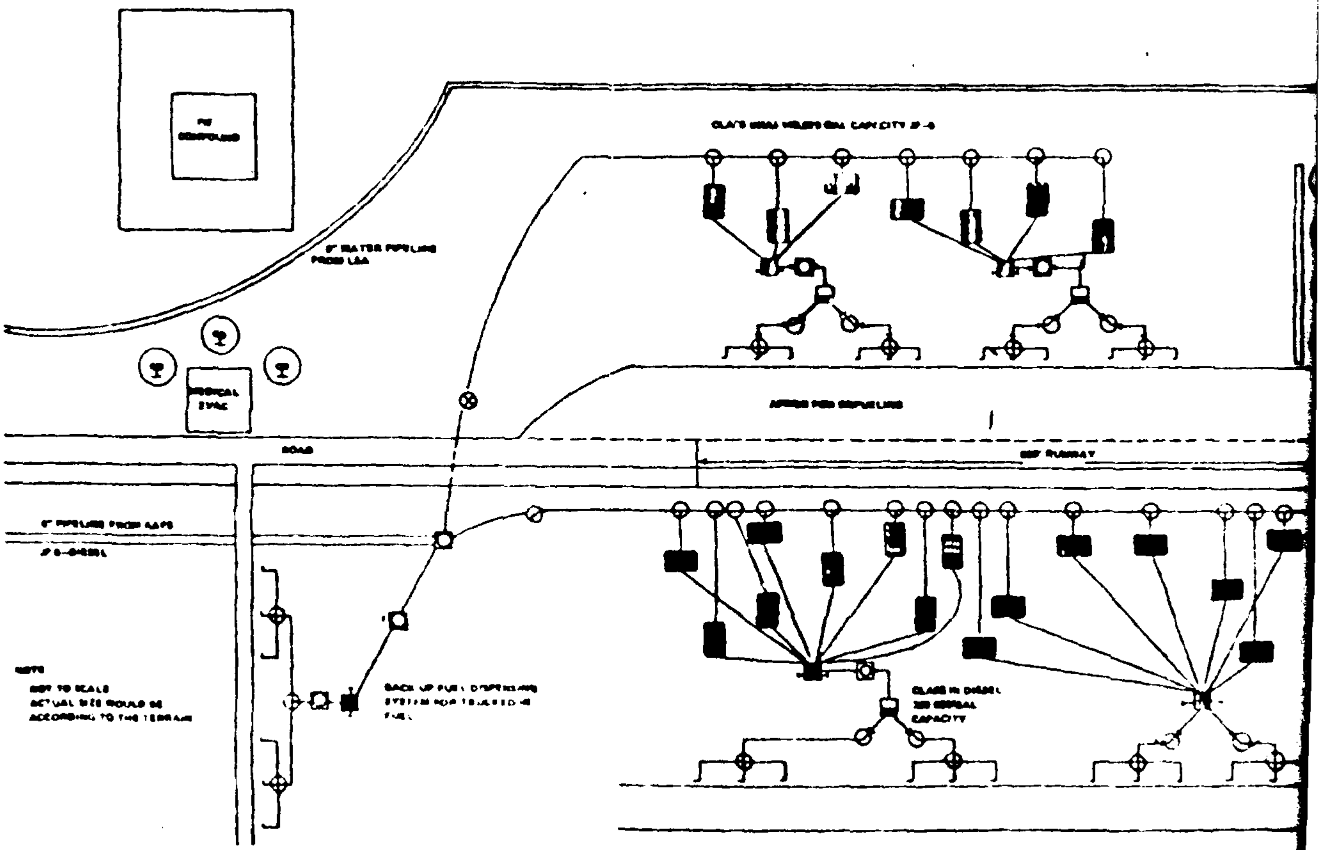
Class I 3 gal water/man	Class III	Class V	Total
14.3	25.3	42.3	81.9

Table I-17. Five Day Level of Supply for Regimental MCATF in CSSA

Unit	Class I Rations	Class I Water	Class III	Class III(A)	Class V	Class V(A)
MCATF	78.8T	73,650 gal	247,900 gal	54,000 gal	3,499.5 gal	187T
CSSA	23.9T	22,935 gal	33,385 gal	70,000 gal		240T
Total	102.7T	96,585 gal	281,285 gal	124,000 gal	3,499.5 gal	427T

Table I-18. Personnel and Equipment Required to Operate CSSA

UNITS	PERS	MRC-83 HMMT	MRC-109 HMMT	DM	GEN 30 KW,60HZ	GEN 30 KW,400HZ	GEN 30KW	Gen 100KW	Forklift 10,000#	Forklift 6,000#	Crane 22T	HMMT	Flood. Set	Weld. Mach.	Fire Trk HMMT	TAEDS
CSSA HQ	67	2	2		2	2						1	1		1	
Class III(C) SP	74								7		6		4		1	1
Class III A SP	48								6		3		4		1	1
Class V A SP	46								6	2	2		3		1	
Class V W SP	46								8	3	3		3		1	
Class I (Water) WP	74								3		1		4			1
Class I	8									1						
Medical Evac	21					1							1			
Graves Reg	16															
Maints Shop	54												1	2		
MT Pool	45			20	2							2	1			
Communication	20	1	1													
Traffic Control (MP)	42	1														
POW Compound	20												1			
Air Facility	36	1	1										1			
Security (Inf Bn)	1,015	2	2				5	1				34				
	1,529	7	8	20	4	3	5	1	30	6	15	37	24	2	5	3



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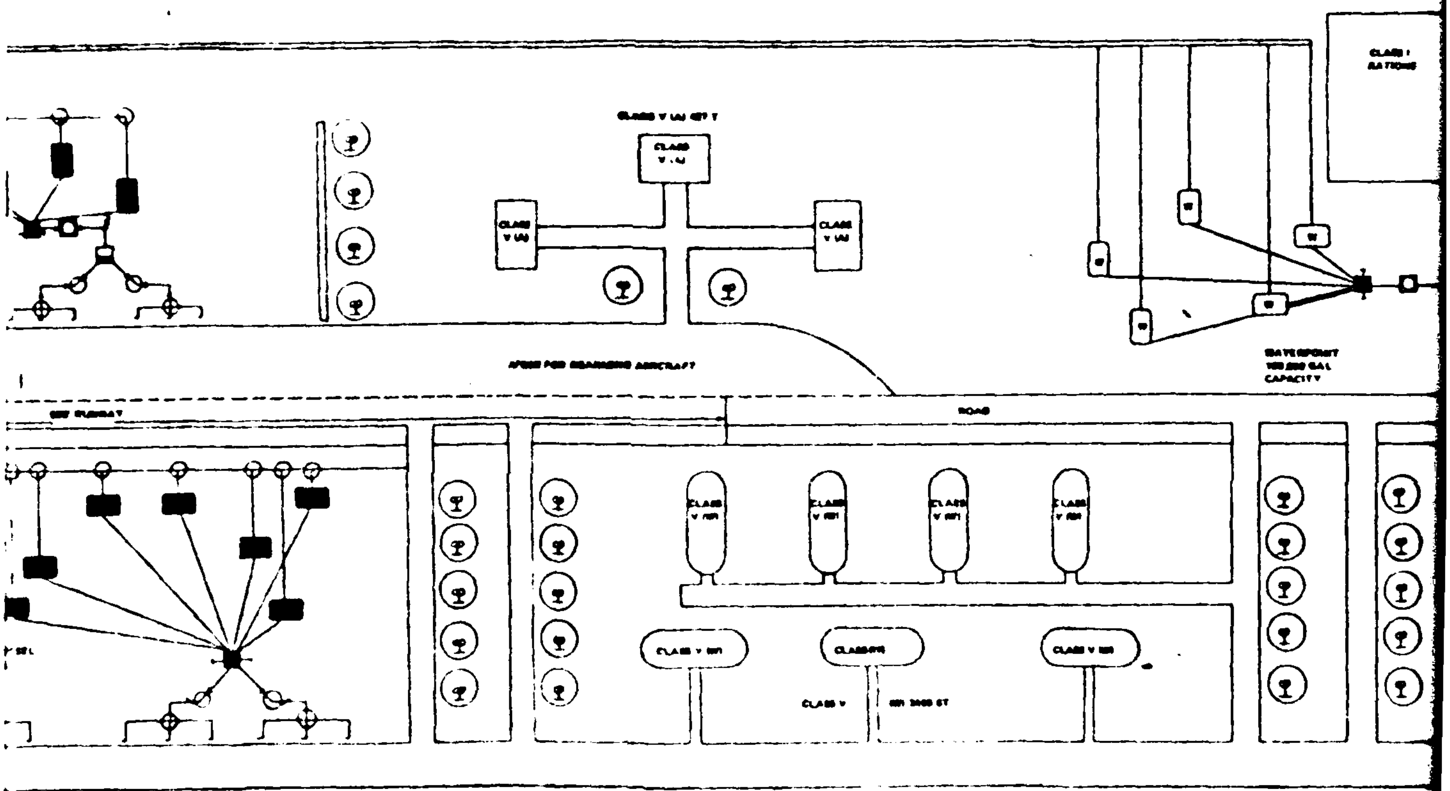
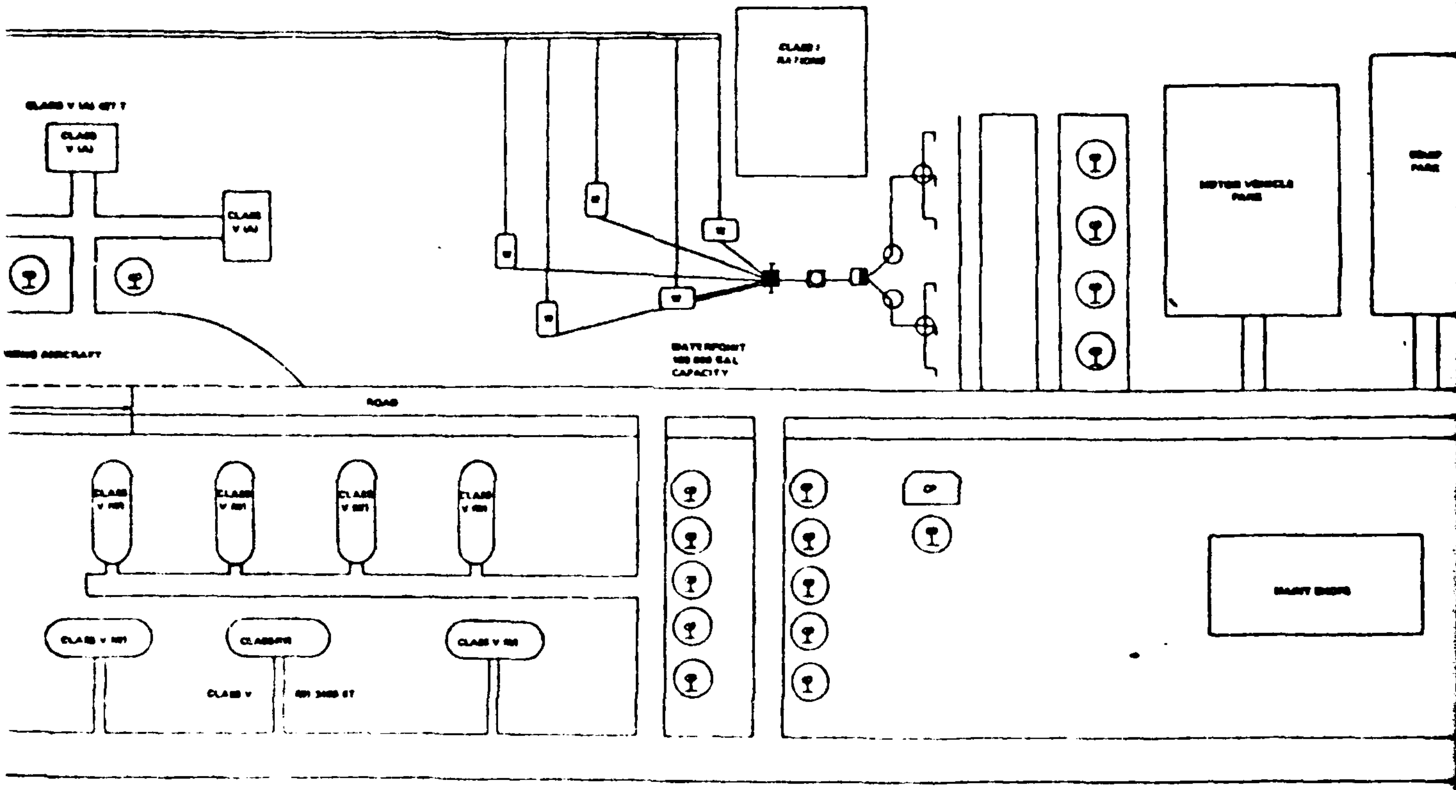


Figure I-9. Representative CSSA



ve CSSA

Table I-19. Summary of Estimated Engineer/Construction Effort Required for CSSA

Facility	Pers	MRS I-100	Med Tractor	Terex Tractor	MRS-I-110	TD-20A	TD-20U	Tractor Whl	Grader	FL 10,000#	FL 6,000#	Crane 30T	MRC83 HMTT	MRC109 HMTT	FireFy HMTT	HMTT	Flood. Set	Weld Mach.	Gen 30KW	Gen 3KW	Gen 10KW	TAFDS	Water Truck	DW
Class III(A) JP-5	26	1	2	1				1			2	6			1		5					1		2
Class III Diesel	52	2	4	2				2			2	3			1		5					1		2
Class V(A)	21				1	2	2	2	1			2			1		3							
Class V(W)	50				2	4	4	2	2			3			1		3							
Class I Water	26	1	2	1				1				1					4					1		2
POW Compound	18																2							
Medical Evac	18																1							
Motor Park																	2	1						
Command Post	40												2	2		1	1							
Maint Shop	26	1	2	1				1									1		2					
Exped Air Fac	46				6	4	4		2	2													2	
Securi[illegible]-Inf Bn)	1,015												2	2		34				5	1			
	1,338	5	10	5	9	10	10	9	5	2	4	15	4	4	4	35	27	1	2	5	1	3	2	6

Note: Maintenance shop clearing and grading person and equipment will also prepare POW-compound, Med Evac, Motor park and CP.

I-5-5. The Mobile Combat Service Support Detachment (MCSSD).

An MCSSD designed to carry one day of supply for one of the three regimental level MCATFs is depicted in paragraph I-5-2. Task Force ALPHA was selected as representative of a regimental level MCATF in the deeper penetration. Therefore, the representative MCSSD was sized to carry one day of supply for Task Force ALPHA. Table I-20 shows the supply requirements and table I-21 shows the MCSSD summary of personnel and equipment. It is noted that the MCSSD would move with, and be protected by, one of the other regimental MCATFs operating in an area no more than 75 NM from the cantonment area.

Table I-20. MCSSD Supply Requirement, One Day Level

Unit	Cl I	Cl III	Cl IIIA	Cl V	Cl VA	Total
TF-ALPHA	59.6	132.7	36.7	523.8	37.4	790.2
MCSSD	5.0	13.5				18.5
Totals	64.6	146.2	36.7	523.8	37.4	808.7

Table I-21. Long Range MCSSD T[illegible] Organization

Detachments	Pers	LVTX-P	LVTX-C	LVTX-R	ADW
H/S Bn	12		2		
LS Co	23	1	1		
MAG(VH)	18	1			
Sup Bn	20	2			
Maint Bn	8	1			
Engr Spt Bn	12	1			
Med Bn	23	4			
MT Bn	124				61
AAV Co	38			1	
Totals	278	10	3	1	61

I-5-6. Planning Factors for Computations of Supply Support Requirements.

Requirements for Class I were based on one ration (3 meals) of the Meal Combat, Individual and one intermediate package (3 bars per man) of compressed trioxane fuel per man per day. Water requirements were based on 3 gallons per man and 2 gallons per liquid cooled vehicle per day. Planning factors for Class I and water are shown in table I-22.

Class III fuel requirements were limited to vehicles and the AAH helicopter. Data on hourly fuel consumption were obtained where possible from the U.S. Marine Corps Table of Authorized Materiel (TAM), Revision 6, dated 25 Nov 1980. For vehicles not listed in the TAM, estimated fuel consumption rates were established based upon comparable vehicles. Fuel consumption of the Tank, combat M1 was obtained from the U.S. Army Tank Automotive Command, Warren, Mich. Hourly fuel ratio for the LVT(X) is considered only for operations ashore. The hours of operations for each vehicle were modified from those contained in the TAM to conform to the tactical operational concepts applicable to a maneuver style of warfare. Class III planning factors are listed in table I-23.

Table I-22. Class I Consumption Planning Factors

Rations	4.25# rations per man per day
Trioxane	0.18# trioxane per man per day
Water	24.9# water (3 gal) per man per day 16.6# water (2 gal) per liquid cooled vehicle per day

Table I-23. Long-Range Fuel Consumption Planning Factors by Type Vehicle

Vehicle	Diesel Fuel Requirement (Gal/hr)	Operational Time (Hrs/day)	Fuel Requirement (Gal/day)	Lube Requirement (Gal/day)
M-1 Tank	26	6	156	2
LVT(X) Amph Aslt Veh	15	6	90	2
ESPAWS 155mm SP Arty	15	6	90	2
FAASV Arty Spt Veh	15	5	75	2
MLRS Rocket Lnchr	15	6	90	2
AVLB Armd Veh Lnchr Bdge	20	5	100	2
LAV Wheeled Lt Armd Veh	6	10	60	1
Recovery Veh, Light	15	5	75	2
Recovery Veh, Hvy	20	5	100	2
Dragon Wagon Cargo Veh	10	5	50	1
AAH Attack Helicopter	150*	3	450*	2

*JP-5

Class V ammunition expenditure rates were generally based on Marine Corps Order 8010.1C dated 8 Dec 1978. Expenditure rates for 155mm and 8 inch howitzers were based on the draft study Class VW Planning Factors, Hq MCDEC dated 1980 after consultation with the Ammunition Branch, Installation and Logistics, Hq, U.S. Marine Corps. Expenditure rates for the 25mm automatic gun were obtained from the U.S. Army Infantry School, Ft. Benning, GA, and modified to conform with maneuver warfare tactical concepts. The Chaparral surface-to-air missile rates were based upon a conceptual armored air defense vehicle with 2 launchers which provided medium range air defense for the MCATF. Class VA rates for the AAH were based on the ordnance capacity of the helicopter, 2 sorties per aircraft per day and complete expenditure of ordnance on each sortie. Class V planning factors are listed in table I-24.

Table I-24. Ammunition Consumption Planning Factors by Type Weapon

Weapon	Rounds/day	Weight/round	Weight/day/weapon
155mm SP Arty	126.84	127.5	16,150.54
8 in SP Arty	89.9	217.2	19,526.28
Mobile rocket launcher	24	1,980	47,520.00
120mm Tank Gun	11.45	71	812.95
105mm Tank Gun	11.45	69	790.05
81mm Mortar	20	18	360.0
TOW Guided Missile	2	89	178.0
Stinger Guided Missile	0.63	47	29.61
Chaparral S to A msl lchr	2	190	380
25mm Automatic Gun	250	1.67	416.67
50 cal Machine Gun	500	0.395	197.5
Engr Line Charge	1	3,220	3,220
7.62mm Machine Gun	1,000	0.094	94
5.56mm Machine Gun	1,500	0.041	61.5
AAH mixed munitions	2 sorties/day	1,557#/sortie	3,114

For each battalion sized unit a weight of 2,000 pounds was added for rifle ammunition, grenades, explosives, flares, etc.

I-6. TECHNOLOGICAL IMPLICATIONS

The battlefield of the future will be fast, lethal and chaotic. A summary of the technological implications of this battlefield on MCATF operations follows. The sequence is that of the preceding paragraphs rather than any order of priority or magnitude.

I-6-1. Tactical Concepts

The basic amphibian postulated in this study was the LVT(X) with its relatively slow water speed. It is not expected that advanced technology will solve this fundamental deficiency by the year 2,000. However, the need to expedite the ship-to-shore movement of AAVs becomes increasingly important. In projecting a full RLT level MCATF ashore, the fundamental goal is to land the maneuver elements of the entire RLT intact (one lift). Such tactical integrity is essential--piecemeal buildup of the MCATF ashore is unacceptable in light of basic threat capabilities. This means that in addition to sufficient LCACs to lift tanks, self-propelled artillery, and other vehicles, very high speed (50 knots), ships are required for the underway launch of AAVs as close to the shore as possible. The clear implication is for dedicated amphibious ships built with advanced technology. It should also be emphasized that greater numbers of AAVs are required to implement the tactical concepts postulated in this study.

I-6-2. Reconnaissance/Intelligence

The technological implications of the reconnaissance/intelligence concept may be summarized as follows:

- Aerial multi-purpose imagery with direct data link to MAGTF Need continuous or constant surveillance/real time output. System combinations: tactical satellites, manned aircraft in combined strikes, sophisticated RPV with MCATF, sensor-ship-MCATF data link.

- Armored recon vehicles in significant quantities.

- Miniature equipment

  - Carry-along RPV for recon company.

  - Night "eyes" to function at same speed/reaction as daylight.

I-6-3. Artillery

Artillery technology implications are summarized as follows:

- Increased need for effective new ammunition for armor targets and for employment of mines as a major anti-maneuver weapon.

- Need new 155 SP artillery (ESPAWS), and equally mobile ammunition vehicle with automatic ammunition transfer for heavy MCATF support.

- Need LAV artillery variant (helicopter transportable).

- There is no requirement for 60mm or 4.2 mortars, 155mm towed, 105mm, or 8 inch howitzers in MCATF operations.

- Need improved surveillance and target acquisition means at MCATF level with long-range target acquisition capability. RPV and SOTAS support required. Q36 and Q37 type radars should be more mobile.

- Need effective and reliable long distance radios for artillery C^3.

- Need automatic tactical fire direction at the battery level, and FSCC/DASC at MCATF. Need to assess MIFASS/TCO capability to meet mobility requirements.

- Need "Honeycomb" pallet concept of ammunition pre-sort for artillery resupply on demand.

I-6-4. Aviation

Aviation technology implications are summarized as follows:

- A survivable and reliable airborne direct air support center (DASC) is required to support MCATF operations.

- Dedicated MED EVAC helicopters are required.

- Night resupply by helicopter probably predominant--need reliable and secure navigation/landing aids such as Pilot Night Vision Devices (PNVD).

- Need PLRS for V/STOL and forward sited helos.

- Marine remote area approach and landing system (MRAALS) at forward sites is required.

- Need airborne C^2 "facility" for MCATF commander.

- A SOTAS and EW configured helo would enhance capabilities.

I-6-5. Combat Engineer

Combat engineer implications are summarized as follows:

- An advanced team/squad vehicle with major focus on rapid, reliable mine clearing is required. Two variants are envisioned: an LAV-E and an LVTX-E. They should have advanced line charges and a blade with anti-magnetic teeth.

- Liquid air explosive (SLUFAE) for mine clearing is required.

- Pre-mixed coolant in 5 gallon containers (water for short term use).

- Need small power generation units in all vehicles to provide self-contained power with engine off. Advance fuel cells should be miniature.

- Need a highly mobile, roll out/roll up, helo landing pad for employment with mobile HSTs. Maybe something like a soft, flexible plastic, or very advanced soil stabilization.

I-6-6. Supply Support

As previously indicated, the supply support concepts imply a major technological effort to facilitate the close coordination required in all interfaces of the demand-pull distribution systems identified. Priority of effort should be placed on the ship-to-MCATF interfaces in amphibious operations. Advanced technology should be exploited in the following areas:

- Direct sea-based support of units in combat ashore.

- Improved mobility and armor protection for CSS vehicles.

- Improved packaging and modular equipment that meet the needs of time sensitive combat at dispersed locations.

- Improved and responsive materiel handling systems.

- Flexible fuel distribution systems compatible with helicopter interfaces.

- Advanced technology helicopters to improve lift and range.

- Improved "hook-up-lift-up" aids for helicopters.

I-6-7. Maintenance

The maintenance implications are summarized as follows:

- Simplified field repair of equipment at the lowest echelon.

- Equipment designed to resist the natural and battlefield environments.

- Efficient, portable, compact and versatile maintenance equipment.

- Maximum standardization of maintenance and calibration equipment that is simple to operate.

I-6-8. Medical Evacuation and Treatment.

Significant improvements in combat casualty evacuation and treatment are implicit in the concepts advanced in this report. Focus must be on trauma prevention, rapid evacuation by helicopter, and expanded shipboard medical facilities.

I-6-9. Marine Corps Science and Technology Objectives.

Appendix A to the draft MLRP contains the science and technology objectives (STOs) of the Marine Corps. Amplification of most of the technological implications summarized in the preceding paragraphs may be found in that appendix. For information there are 12 STOs organized by mission area as follows:

- 6 land warfare
- 1 tactical air warfare
- 1 naval (amphibious) warfare
- 1 tactical C^3I
- 2 mobility (air, sea)
- 1 manpower and training

The readers of this report are encouraged to review the STOs as a means of validating many of the technological implications addressed.

I-7. CONCLUSIONS AND RECOMMENDATIONS

There is a feasible set of tactical, CS, and CSS concepts suitable for operation of MCATFs on deep penetration missions in the long range time frame. The CS and CSS concepts described above require doctrinal, organizational, and equipment changes and improvements that are justified by the tactical flexibility and capability that they allow MCATFs to display in executing their missions.

It is recommended that these concepts be adopted as developmental concepts by the CG, MCDEC. It is also recommended that these concepts be considered as general guidance for the initiation and evaluation of advanced or exploratory development programs needed to provide the capability for effective MCATF operations in the long range time frame.

PART II--MID-RANGE

II-1. INTRODUCTION

The MCATF tactical and support concepts described in Part I represent a desirable goal for developments in the long-range time frame. Mid-range concepts focus on what is possible or feasible rather than on a conceptualization requiring new development programs. In terms of the POM process amidst constrained budgets, mid-range weapons systems and equipment are largely "locked-in." The central question is what improvements can be achieved in MCATF tactical and support capabilities with existing or programmed systems? Part II addresses this central question which includes the CS and CSS critical issues identified in the Post Exercise Evaluation of the MCATF-Phase IV operation. The discussion will emphasize only the differences in mid-range concepts from the established long-range goals to draw attention to deficiencies in current capabilities.

II-2. TACTICAL CONCEPTS AND CRITICAL ISSUES

Paragraph 202, Concepts, OH 9-3 (REV A) (Table I-1) adequately identifies the basic principles of a maneuver style of warfare applicable as well, to MCATF operations in the mid-range period. The crux of contemporary problems is not the tactical concept fundamentals; rather, it is concept interpretation, application and the extremely limited inventory of capabilities appropriate to the conduct of MCATF operations. The evaluation report of the Phase IV exercise identifies and discusses seven critical MCATF issues (listed in figure II-1). While the report addresses many other problems, these seven constitute the major identified MCATF deficiencies or issues, and each issue is addressed in some detail in applicable succeeding paragraphs. Before addressing those issues, however, it was necessary to review and evaluate the overall tactical concept as applied in the exercise and addressed in the Phase IV evaluation report.

Issue	Identified Deficiency
Speed/Time/Distance	Artillery mobility
Flexibility/Adaptability	Reconnaissance/Screening Operations
Firepower Delivered	Close Air Support (CAS)
Command and Control Within the MCATF	Communications
Survivability	Air Defense
Sustainability Within the MCATF	Mobility and survivability of the CSS forces
Command and Support from Higher Headquarters	Command and Support at a distance

Figure II-1. Critical MCATF Issues

The review identified a basic discrepancy between (1) the tactical principles enunciated in paragraph 202 of OH 9-3 (REV A) and expanded in Part I above, and (2) the tactical concept applications in the exercises and in the tactical perceptions of the "ideal" MCATF portrayed in the Phase IV evaluation report. The origin of this discrepancy is easily understood when one considers that mechanized operations, combined arms, and a maneuver style of warfare are all relatively new to the Marine Corps. Also, it should be understood that a full regimental level MCATF has yet to be formed or exercised. However, there is sufficient experience and evidence to recognize the difference now and to eliminate it, at least in concept, for the mid-range.

The three basic elements of the concept discrepancy may be briefly identified as follows:

- Unidirectional vice omnidirectional perception of the nature of MCATF maneuver.
- Applications focused on a mobile task force (MTF) plus supporting arms rather than on definitional "combined arms."
- The orientation on MCSSDs and an MSR rather than the perception of no secure rear area or stable FEBA.

The Phase IV evaluation report gives the perception of the MCATF as a unidirectional force. This perception probably originated in the tactical concepts associated with a single battalion level MCATF and before the concepts paragraph in revision A of the OH 9-3 handbook was published. The fact that it has been perpetuated in higher level exercises and in the Phase IV evaluation report is unfortunate because this perception is the root cause of several of the critical issues. Figure II-2, extracted from the evaluation report, is associated with a discussion of a notional "ideal" Marine Corps MCATF. Figure II-3, extracted from paragraph 3.2.2 of the report presents a diagram of the MCATF in motion. Note the single direction of movement and the orientation to a definable front (location of all maneuver elements), supporting artillery massed in trace, and a definable rear (location of CSS elements). Note also the absence of security or reconnaissance forces to the rear of the CSS elements. This perception of a front-to-rear orientation and tactical deployment of forces generates a very basic vulnerability; i.e., the relative exposure of the MCATF HQ, artillery, and MCSSD to enemy attack from the flanks or rear. It stands in contrast to the concept fundamentals enunciated in OH 9-3 (REV A).

This relative vulnerability is addressed in the Phase IV evaluation report; however, the problems are primarily thought to be generated by "mobility mismatches" rather than the unidirectional nature of the tactical concept itself. This is best illustrated in paragraph 3.2.6 of the report which addresses Mobility and Survivability of CSS Forces, one of the seven critical areas. Although this subject will be further addressed in a following paragraph, its relationship to the basic tactical concept will be outlined here.

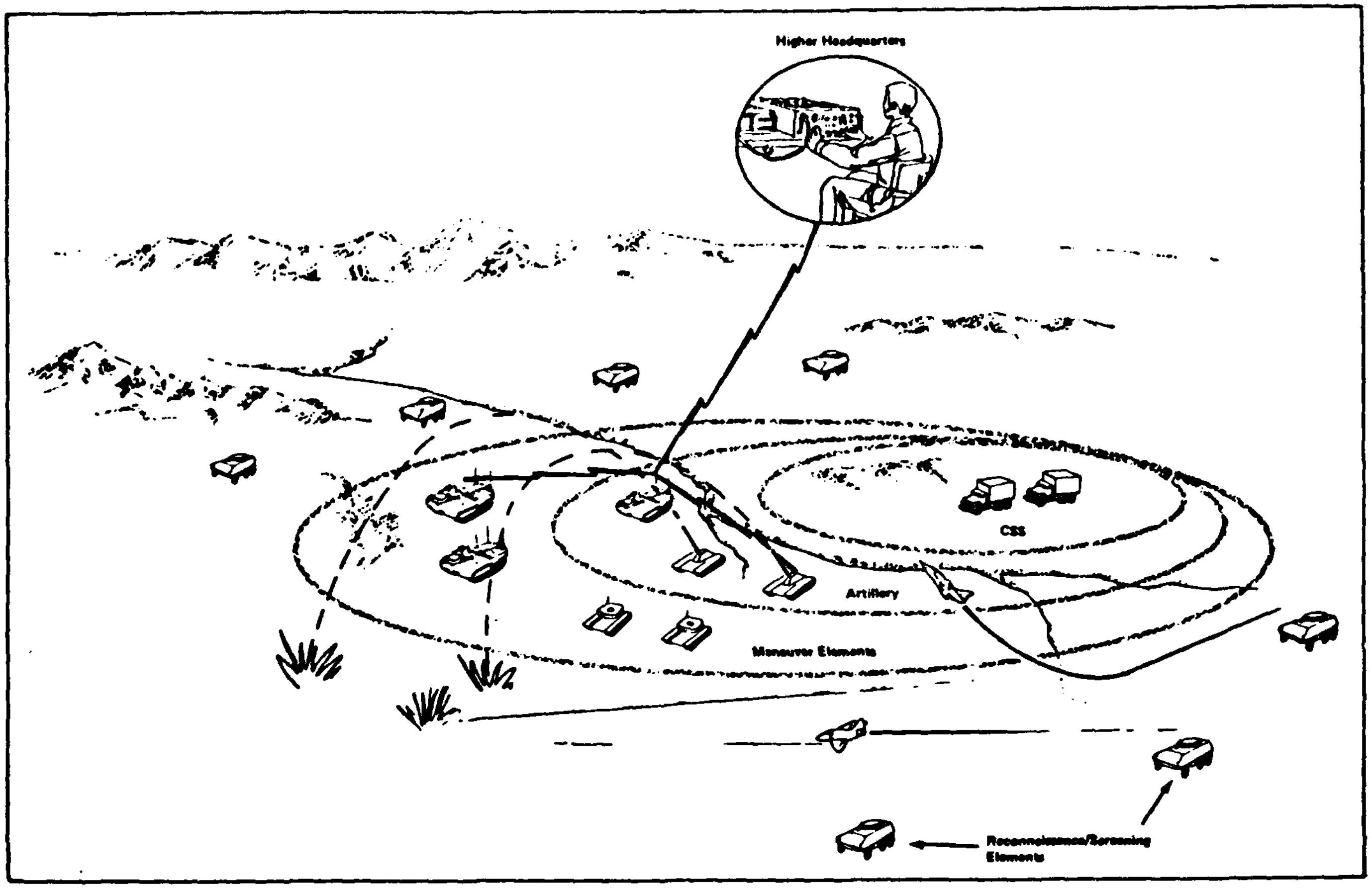


Figure II-2. A Representation of the MCATF

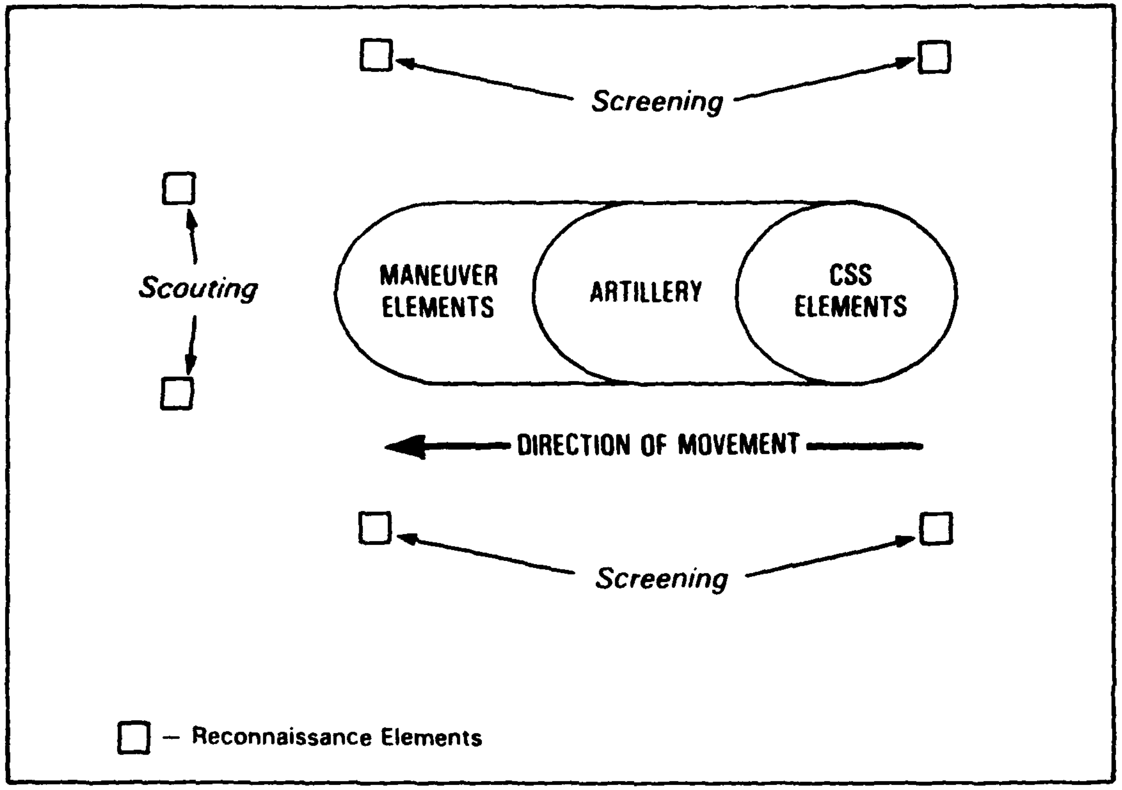


Figure II-3. The MCATF in Motion

Figure II-4, extracted from the Phase IV evaluation report, is proported to depict the behavior of an "ideal" MCATF in which there is no mobility mismatch between the maneuver and CSS elements. The figure shows four threat scenarios and the hypothetical deployment of MCATF assets; the artillery, MCSSD and headquarters for a core around which the maneuver elements are deployed in attack (A), bypass (C and D), or withdrawal (D). Note again the unidirectional perception of the MCATF; note also that in three of the four representations, the enemy is perceived to be deployed in only one direction from the MCATF. This is in direct contrast to the fundamental percepts upon which OH 9-3 (REV A) is based, i.e., the perception that in many situations MCATFs will be operating among enemy units whose cohesion has been shattered. The objective is not to engage cohesive units head-on. The existence or potential of enemy forces being in multiple directions becomes basic to the tactical perception of the battlefield.

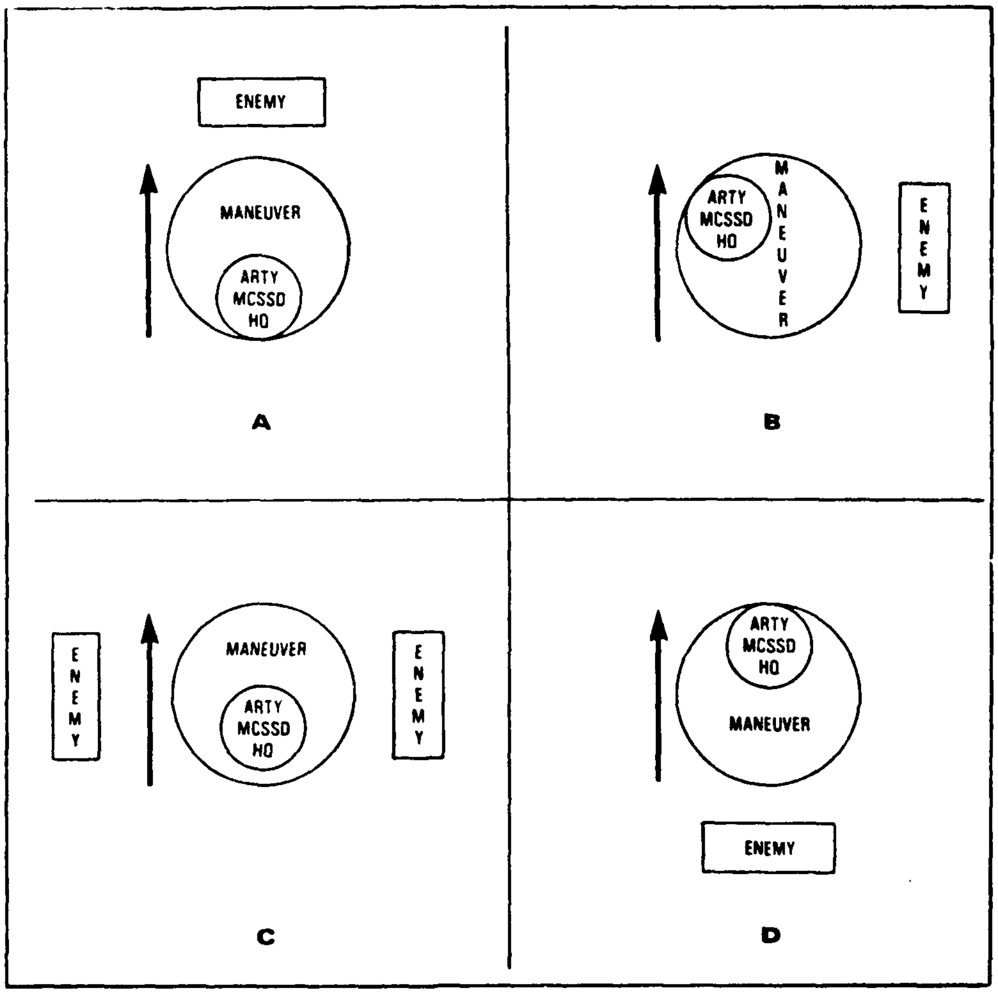


Figure II-4. Equally Mobile MCATF Assets Under Differing Threat Scenarios

The contradiction between definitional focus on combined arms and applications focused on the MTF plus supporting arms, is clearly evident in the exercises and the evaluation reports. Although OH 9-3 (REV A) attempts to temper the contradiction, it also tends to struggle with the transition to combined arms tactics and techniques. Such institutional struggle is inevitable for the contemporary Marine Corps; however, the transition will be greatly expedited if omnidirectional perceptions and applications are adopted as normal MCATF tactical concepts. The term MTF should be eliminated from the MCATF lexicon.

The third element of the discrepancy is less understandable. The perception of no secure rear area or stable FEBA is apparent in both OH 9-3 (REV A) and in the evaluation report. How, then, can one envision an MSR, much less a massive, road bound MCSSD effectively supporting a MCATF from an MSR? The answer probably lies basically in (1) the illusion of a definable front-to-rear unidirectional orientation, (2) the lack of full CSS play in the exercises, and (3) the lack of force-on-force free play exercises. Adoption of the omnidirectional perception will immediately eliminate this contradiction--MSR disappears from the MCATF lexicon and the MCSSD is envisioned only in multiple regimental MCATFs, and only after compatible mobility and survivability have been provided.

This discussion supports tactical concept focus on the fundamentals of a maneuver style of warfare for MCATFs in the mid-range. It further provides a context for discussion of mid-range CS and CSS concepts, and the critical areas identified in the Phase IV evaluation report. Most important, it enunciates an eighth critical issue, an omnidirectional vice unidirectional perception of contemporary and mid-range MCATF operations. It is hoped the discussion will be interpreted as a positive basis for concept improvement rather than an implied criticism of the MCATF exercise and evaluation effort. In fact, given the extremely limited inventory of assets appropriate to the conduct of MCATF operations, the effort may be described as magnificent.

In summary the fundamentals of the MCATF tactical concept for the mid-range are the same as for the long range, except that:

- The existence of a BSA in the amphibious mode is situationally and capability dependent. When a BSA is established, it will be separated from the MCATF by an area that is not secure.

- Equal or compatible mobility is required for all systems and equipment on the MCATF battlefield. Equal or compatible survivability is desired for all systems and equipment on the MCATF battlefield, but achievement of this goal may not be feasible in the mid-range.

II-3. COMBAT SUPPORT CONCEPTS

Combat support concepts for the mid-range will be illustrated in a base regimental level MCATF containing four battalion level maneuver elements. Again, the focus is on the trend toward combined arms; i.e., attacking an enemy with two or more weapons systems simultaneously in such a manner that any action the enemy takes to avoid or minimize the effect of one system makes him more vulnerable to another.

II-3-1. Reconnaissance/Intelligence

Reconnaissance/screening operations are identified as one of the seven critical issues in the Phase IV evaluation report. The fundamental problem is the lack of an adequate reconnaissance (recon) vehicle. There is no known procurement program which would form the basis for establishing mobile recon companies with dedicated vehicles. The Phase IV evaluation report indicated that the MPWS/LAV surrogates used in the exercise show considerable promise.

It would appear that the most logical method of resolving this critical issue is by expanding the LAV procurement program to include sufficient recon variants for at least one mobile recon company in each division recon battalion in the mid-range period. For purposes of this study, it is postulated that a mobile/mechanized recon company will be attached to a regimental level MCATF from the division recon battalion. Due to the lack of an existing procurement program and predictably constrained budgets, it is assumed that no more than one mobile recon company per division would be formed in the mid-range. This assumption constrains the concept of employment.

In contrast to the long-range concepts, the following reconnaissance employment concepts are envisioned in support of a regimental MCATF in the mid-range:

- The elements of the attached recon company would normally be task organized and further attached to the battalion maneuver elements.
- Due to the paucity of recon assets, the mobile recon company would be placed in direct support of the maneuver elements or in general support of the MCATF only in situations where unit separation of the maneuver elements is minimal.
- The attached recon elements would operate one-to-three hours out from the maneuver battalions. Deeper recon tasks would be performed by other elements of the recon battalion and force recon company in both direct and general support missions.
- The attached recon elements will be employed on a semi-continuous basis. They will require some demand-pull supply support but will frequently be mission self-sufficient.
- The demand for near real time intelligence is similar to the long range; however, increased intelligence production is envisioned at the MCATF level only.
- Airborne recon and surveillance must extend the limited mobile recon unit capabilities.

In summary, the MCATF must have effective mobile recon assets, however limited they may be in the mid-range. MCATF operational effectiveness is highly dependent on near-real-time intelligence, particularly when attempting to adopt a maneuver style of warfare.

II-3-2. Artillery Support

Artillery mobility is also one of the critical issues identified in the Phase IV evaluation report. The following extract from that report serves as a point of departure for discussing this issue:

> "The main factor which tends to slow the movement of the MCATF is the inability of the artillery to displace as rapidly as the maneuver forces move. This difficulty was made apparent in the Phase IV exercise by the requirement that the maneuver elements would not be permitted to move beyond the range of their artillery support. Although there are some who would undoubtedly relax this rule in a real combat environment, many situations will exist in which continuous artillery support is required."

The evaluation report cites three basic problems:

- The use of towed artillery with wheeled prime movers <u>not</u> designed for off-road travel.
- Relatively slow displacement of self-propelled artillery batteries due to wheeled ammunition supply trucks <u>not</u> designed for off-road travel.
- Insufficiency of artillery density in normal allocation of one direct support battery per maneuver battalion.

The basic causes of this critical issue are believed to be rooted in the unidirectional perception of the MCATF tactical concept as addressed in paragraph II-2 and in continuing to view artillery as a supporting arm vice an inherent fundamental element of combined arms. Under an omnidirectional MCATF tactical concept using artillery as a fundamental element of combined arms, the basic artillery concept should be attachment of SP batteries to the maneuver elements. This concept provides direct, continuous support at extended ranges; it facilitates rather than inhibits rapid movement of maneuver elements; it facilitates security and logistic support. A loss in capability to mass artillery fire responsively is inherent to this concept. However, in many situations, batteries attached to one maneuver battalion could provide reinforcing fires to the batteries of other maneuver battalions on a non-interfering basis.

In view of the above, a five-battery SP artillery battalion is envisioned as being commonly attached to a regimental MCATF. In consonance with current Marine Corps programming for the mid-range period, this battalion would contain three 155 (SP) batteries of six tubes each and two 8" (SP) batteries of six tubes each. This programmed organization is considered adequate; 8 tube batteries would be preferred but are not considered feasible within constrained budgets focused on procurement of a large M-198 inventory. The SP battalion envisioned in attachment to a regimental MCATF would constitute the entire SP inventory of a Marine division.

In this concept, one battery would commonly be attached to each of the four maneuver elements; the fifth battery would either move with the MCATF Hqs

in a general support/reinforcing role or be attached to one of the maneuver battalions in special situations. When additional artillery support for a specific MCATF operation is required, the establishment of one or more fire support bases by MAGTF elements external to the MCATF would be preferred over expanding the MCATF artillery attachments to include towed batteries. This simply follows the theory of equal or compatible mobility and survivability for all MCATF elements. Appropriately placed fire support bases could provide general support/reinforcing fires in at least some portions of the MCATF TAOR.

The above concept solves or alleviates the basic problems addressed in the Phase IV evaluation report except for the problem of an ammunition vehicle in the SP batteries. Procurement of the armored dragon wagon for this purpose is advocated and it is understood the Marine Corps has a viable procurement option in this regard.

II-3-3. Close Air Support

Results from the MCATF-Phase IV operation established that a serious deficiency is likely to occur in the delivery of close air support (CAS). This deficiency focused primarily on command and control as it relates to requests for non-preplanned missions, DASC coordination with the appropriate FSCC, and effective mission control by forward air controllers.

As discussed in the final report of the Direct Air Support Center (DASC) Requirements (1981-1990) study, published on 30 December 1981, these problems are fundamentally ones of communications. Due to the characteristics of DASC equipment this study found that to be effective during the mid-range period, the DASC must operate from a relatively secure area with only limited displacements as necessary to maintain coordination with the senior FSCC. This location will frequently separate the DASC from forward MCATF units by up to 30-50 miles. Such distances, together with enemy ECM capabilities and low altitude flight profiles of aircraft necessary to avoid enemy air defenses, challenge current communications capabilities. However, the introduction of new, secure, longer range, and more reliable radios plus the use of relay stations are expected to significantly mitigate current communications deficiencies.

The DASC study also concluded that forward air control could be achieved more effectively by expanding the personnel of battalion and regimental tactical air control parties (TACPs) to provide a capability of round-the-clock operations in coordination with MCATF FSCCs. Based on procedures set forth in OH 5-4, Close Air Support (CAS) Handbook, it is expected that the MCATF FACs will be increasingly responsible for coordinating control of CAS missions in target areas. This tasking, as highlighted in the MCATF Phase IV tests together with the high mobility characteristics of MCATFs, will require that FACs be mounted in dedicated high mobility vehicles that provide essential equipment for communicating with support aircraft, the supported unit, and the DASC.

Other aviation operating concepts for mid-range MCATF operations are similar to the long range.

II-3-4. Antiair Defense

Air defense was also identified as a critical issue in the Phase IV evaluation and the report indicated that perhaps no other MCATF shortfall is as uniformly accepted as the need for improved air defense. The need is expressed as "more and better air defense assets"--"carried in more mobile vehicles." Both an antiair gun and mobile missiles are cited as "valuable improvements." A second issue, who should control the assets, is also discussed but no contemporary recommended resolution is offered.

The focal point of this problem is the lack of a protected, mobile air defense system. Stinger-equipped FAAD teams carried in AAVs do not solve the problem. Further, it is understood from the MCDEC LAV/MPWS Directorate that a LAV air defense variant will probably not be in the mid-range inventory associated with the light armored assault battalion (LAAB), despite LAV(AD) identification in the conceptual organization. A possible option would be procurement of Chaparral/DIVAD air defense systems (or their replacement) in conjunction with the US Army; however, such action appears unlikely. The net result is an unsolved deficiency in the mid-range which suggests that deep MCATF penetrations would be very vulnerable in many situations involving limited MAF air superiority.

Control of SAM firing conditions is not considered to be part of the issue by this study group. It is firmly believed that OPCON or control of the firing conditions must be centralized within the total air defense system of the MAGTF. The FAAD assets would be attached to the MCATF for purposes of movement, control, protection, and logistic support.

II-3-5. Combat Engineer Support

The mid-range concept is identical to the long range concept. The principal problems in executing this concept are (1) the lack of combat engineer vehicles that are tracked, fully armored, and have mine clearing capabilities, and (2) the lack of a mobile gap crossing capability, i.e., the AVLB. As currently programmed basic mid-range techniques are focused on combat engineer squads/teams carried in AAVs in conjunction with AAVs that can be configured/dedicated to line charges. These equipment-limited techniques are considered to be a serious mid-range deficiency. The only known mid-range solutions to these problems are not currently programmed. First, procurement of the M-728 Vehicle, Combat Engineer, Full-Tracked should be considered, four vehicles for each combat engineer company designated or designed to support a regimental level MCATF. Second, recommendations for procurement of the AVLB to support MCATF operations have been made in several studies over the last four years--to date no known procurement has been initiated although such procurement is informally understood to be under consideration. This study group advocates such procurement, again four vehicles for each combat engineer company envisioned in support of a regimental level MCATF.

II-3-6. Tactical Communications Support

Communications is also identified as a critical issue in the Phase IV evaluation report. The following extract from the report serves as a point of departure:

"One of the most readily apparent problems during the Phase IV exercise was the problem of communications. The force was widely dispersed, experiencing continual terrain masking, and attempting to communicate with radios that were designed for standard infantry warfare." The evaluation report advocates two steps towards recognition of the importance of radio communications:

- The need for vehicle separation.
- An appreciation of the distances over which communications must occur.

Three major problems are cited:

- Inadequate, under powered assets.
- Traffic and net density.
- Training.

Introduction of new, longer range, and more reliable radios will go a long way toward alleviating this problem. In addition, increased use of airborne relay is envisioned. Techniques to control traffic and net density are basic to MCATF evolution and it is likely that this problem together with the training problem will be alleviated in the normal sequence of follow-on exercise experience.

II-4. COMBAT SERVICE SUPPORT CONCEPTS

Primary MCATF organizational focus has been placed on a notional, regimental sized MCATF task organized from the assets of one Marine division. It contains four battalion level maneuver elements and a headquarters element, and serves as a base case for designing the concepts and distribution systems. It is basically the same MCATF as presented in the long range except for weapons and equipment.

II-4-1. Supply and Transportation Concepts

The principal differences in supply and transportation concepts for the mid-range derive from limitations in availability and capability of tranport helicopters. In the long-range period, a planning radius of operations for helicopter resupply of approximately 75 NM was selected as representative of normal environmental conditions. For the mid-range time frame, this radius may be more like the 50 NM planning factor for current helicopters. It is not likely that an HXM with increased range/payload capabilities will be in the inventory in any significant numbers by the mid-range. Short but sustained penetrations (e.g., 25 NM) could be maintained by helicopter resupply, but penetration out to 75 NM could be sustained only under very favorable helicopter operating situations.

Deeper penetrations (out to 150 NM or so) could be supported, using centroidal-elliptical supply into and out of an MCSSD, with a heavy commitment of FMF helicopter assets (see figure II-5).

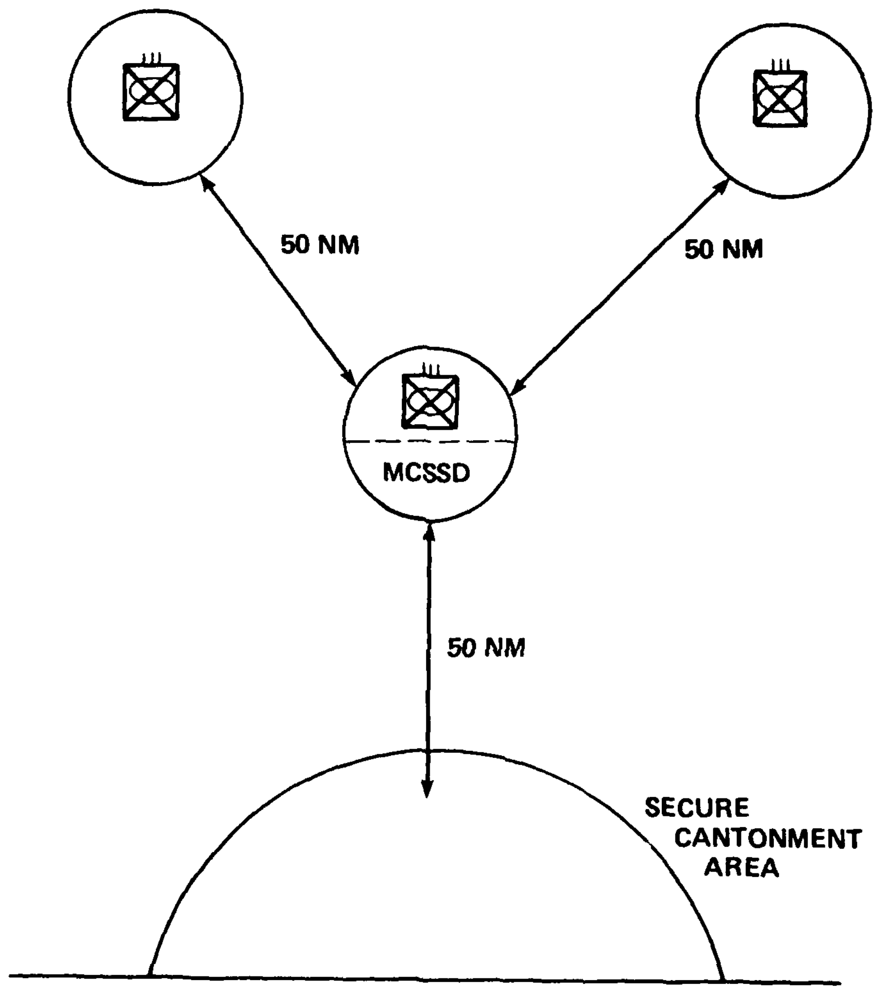


Figure II-5. Example Penetration Using One MCSSD

Unlike the long range concept which envisioned a theoretical projection of 225 NM using two MCSSDs collocated and protected by two of the three regimental MCATFs, the mid-range concept appears limited to one MCSSD due to predictably constrained assets. Both CSS organization/equipment and heavy lift helicopter availability in the total force commitment are limited and the MAGTF-wide demand on these limited assets is heavy. The ability to create and support one MCSSD in conjunction with other demands is optimistic; to postulate the establishment of two MCSSDs is considered infeasible in the mid-range. Penetrations from 150 out to 300 NM would be extremely risky and difficult to support in the mid-range. An extended land route, negotiated by protected convoys of supply vehicles carrying supplies both for themselves and for the MCATF, could be easily interdicted or delayed by enemy action, with great jeopardy to the MCATF. In spite of its drawbacks, air drop of supplies to a MCATF should probably be planned as backup to land routes for deep (200-300 NM) penetration.

In amphibious operations in the mid-range, it may be difficult or impossible to provide direct sea-based support of MCATF penetrations. Available and dedicated shipping and the techniques for adequate materials handling and packaging transition may not be available. To overcome these deficiencies it may be necessary to have a concatenate supply support system using one or more secure BSA(s) or CSSA(s) as the link between the ships and the MCATF. In light of mid-range constraints, this concept is considered applicable in many general situations and for practically all situations in which the MCATF is operating some distance inland. However, it should be understood that the establishment of a secure BSA or CSSA link to the MCATF involves a heavy cost or price in tactical commitment and flexibility. First, in amphibious forcible entry, the area to be used must be secured or seized. Second, the area must be defended in depth by available infantry forces because it is a potential Achilles' heel. Third, in relation to a mobile/mechanized enemy force, it must be located in restricted terrain which facilitates infantry defense and prohibits or severely restricts mechanized attack. Fourth, it should be accessible to LCACs.

In situations where these conditions can be obtained, the concatenate supply support system would focus on selective unloading of shipping in a demand-pull system. The LCAC would be the primary lift means, ship-to-BSA/CSSA; and the helicopter would be used for the BSA/CSSA circuit to the unit trains. Depending on the situation, the BSA/CSSA would stock 1-5 days of supplies, with the stockage by Class a variable. The objective is to minimize storage in order to avoid creating a massive lucrative target. The BSA/CSSA would include a forward rearm/refuel capability for attack helicopters. The MCATF unit trains would again carry one day of supply.

The BSA/CSSA envisioned here is a departure from the classic BSA depicted in contemporary doctrine and associated with frontal amphibious assault. It should facilitate MCATF applications of a maneuver style of warfare inland or along the littoral rather than inhibit such applications.

A summary of the applicable supply support concepts is depicted in table II-1.

Table II-1. Mid-Range Supply Support Concepts

TYPE ORGANIZATION	APPLICABLE SUPPORT CONCEPT: SELF SUFFICIENCY	SINGLE CIRCUIT	CENTROIDAL-ELLIPTICAL	CONCATENATE
BATTALION MCATF OR LAAB (LAV BN)	X			
REGIMENTAL MCATF	X	X		X*
THREE REGIMENTAL LEVEL MCATFs	X	X	X	

*With Supporting BSA/CSSA

II-4-2. <u>Other CSS Concepts</u>

Concepts for the other CSS functions described in the long-range are adequate for the mid-range as well. Some minor modifications or limitations may be imposed by unavailability of resources, but the concepts are general enough and flexible enough to be adopted.

II-5. QUANTITATIVE ANALYSIS OF REQUIREMENTS

Mid-range supply support regiments were determined for (1) the base regimental MCATF, and (2) the three regimental level MCATFs formed from the resources of two Marine divisions. In addition, a representative MCSSD was developed. Requirements for a representative CSSA in the mid-range approximate those presented in Part I, except for Class V storage requirements which are significantly less. Refined and detailed computations of the difference in the CSSA requirements for the mid-range was not considered warranted--the scale of effort and operational organization are almost identical to that presented in Part I.

II-5-1. The <u>Base Regimental MCATF</u>

Table II-2 depicts the organization of the regimental MCATF, its major weapons systems, vehicles and unit trains. The number of logistic vehicles (dragon wagons) in the unit trains were calculated to carry one day of supply. Table II-3 depicts the requirements in tonnage by class. Water was calculated at three gallons per man per day. It is emphasized that Class I is the only *constant demand*--distribution of other classes will vary daily in the demand-pull system. Table II-4 summarizes the logistic vehicle requirements by class. Table III-5 provides a comparison of the total vehicles in the unit trains to the total vehicles in the MCATF. These percentages are considered to be very favorable "tooth-to-tail" ratios. CH-53E helicopter requirements to support distribution of one day of supply to the unit trains are shown in Table II-6.

II-5-2. <u>The Three Regimental MCATFs</u>

Tables II-7A through II-7C depict the detailed organization of the three regimental level MCATFs. Again, the number of logistic vehicles in the unit trains were calculated to carry one day of supply. Table II-8 depicts the requirements in tonnage with water again calculated at three gallons per man per day. Table II-9 summarizes the logistic vehicle requirements by class; table II-10 provides a comparison of the vehicles in the unit trains to the total vehicles in the MCATFs. CH-53E helicopter support requirements are shown in table II-11.

II-5-3. <u>A Representative Mid-Range MCSSD</u>

A representative MCSSD in the mid-range is shown in table II-12; it is designed to carry one day of supply for TF-ALPHA, the heaviest of the three regimental MCATFs. It is noted that the tonnage required to support TF-ALPHA in the mid-range is only 66.4 percent of that required in the long range.

Table II-2. Regimental Level MCATF; Mid-Range

UNITS	PERS	LVTP-7A1	LVTC-7A1	155(SP)	ADM	8"(SP)	M60 Tank	AVLP	5/4T HMTT	MG .50 cal	TOW	STINGER	Mortar 81mm	MG 7.62	3 kw	10 kw	30 kw
ME-A																	
H/S Co Inf Bn	142	6	2						1	6	1				1	1	
Wpns Co	61	8								8	1		8		1		
Rifle Co (3)	360	27								27	6				3		
155(SP) Btry	90	3		6	6				1	15					1	1	
Arty FO Tm	12																
Tank Co	64	1					14			15				14			
Engr Plt	41	6						1									
FAAD Det	13	2								2		6					
AAV Co(-)	163																
TOTAL	946	53	2	6	6		14	1	2	73	8	6	8	14	6	2	
ME-B																	
H/S Co Inf Bn	142	6	2						1	6	1				1	1	
Wpns Co	61	8								8	1		8		1		
Rifle Co (3)	360	27								27	6				3		
155(SP) Btry	90	3		6	6				1	15					1	1	
Arty FO Tm	12																
Tank Co	64	1					14			15				14			
Engr Plt	41	6						1									
FAAD Det	13	2								2		6					
AAV Co(-)	163																
TOTAL	946	53	2	6	6		14	1	2	73	8	6	8	14	4	2	
ME-C																	
H/S Co Tk Bn	84	5	2						1	5	1				1	1	
Tank Co (2)	128	2					28			30				28	2		
Rifle Co (2)	240	18								18	4						
155 (SP) Btry	90	3		6	6				1	15					1	1	
Arty FO Tm	8																
Engr Plt	41	6						1									
FAAD Det	13	2								2		6					
AAV Co(-)	112																
TOTAL	716	36	2	6	6		28	1	2	70	5	6		28	4	2	
ME-D																	
H/S Co Inf Bn	142	6	2						1	6	1				1	1	
Wpns Co	62	8								8	1		8		1		
Rifle Co (4)	480	36								36	8				4		
8"(SP) Btry	102	3			6	6			1	9					1	1	
Arty FO Tm	16																
Engr Plt	41	6						1									
FAAD Det	13	2								2		6					
AAV Co(-)	187																
TOTAL	1042	61	2		6	6		1	2	61	10	6	8		7	2	
MCATF Hq																	
Hq Co	104	9	4						5	9	2				2	5	
8"(SP) Btry	102	3			6	6			1	9					1	1	
Tank Bn Det	2																
Arty Bn Det	5																
Engr Co Hq	4																
FAAD Det	14	2								2		6					
Arty Hq Btry	97	8	2						2	8					2	1	1
Targ Acq Det	21																
Tank Co	64	1					14			15				14			
Recon Co	89								11	11							
AAV Bn Det	5																
AAV Co(-)	81																
TOTAL	588	23	6		6	6	14		19	54	2	6		14	5	7	1
	4238	226	14	18	30	12	70	4	27	331	33	30	24	70	27	15	1

UNIT TRAINS	PERS	LVTP-7A1	LVTC-7A1	LVTR-7A1	M-578	M-88	ACV
MCSSU (ME-A)							
HST	38	1					9
H/S Co	9		1				
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
Tanks	13	1				1	
AAV Det	34	1		1			
TOTAL	127	7	1	1	1	1	9
MCSSU (ME-B)							
HST	38	1					9
H/S Co	9		1				
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
Tanks	13	1				1	
AAV	34	1		1			
TOTAL	127	7	1	1	1	1	9
MCSSU (ME-C)							
HST	38	1					9
H/S Co	9		1				
Bn AID	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1				2	
AAV	34	1		1			
TOTAL	142	7	1	1	1	2	9
MCSSU (ME-D)							
HST	38	2					9
H/S Co	9		1				
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
AAV	34	1		1			
TOTAL	114	7	1	1	1		9
MCSSU (MCATF Hq)							
HST	44	2					12
Hq Co	9		1				
Tank Co	13	1				1	
Recon	1						
FAAD	1						
MCATF-AID	8	2					
Arty	11				1		
Hq Btry	13	1					
AAV	30	1		1			
TOTAL	130	7	1	1	1	1	12
	640	35	5	5	5	5	48

Table II-3. Mid-Range Regimental MCATF Tonnage Requirements For One Day of Supply

Maneuver Elements	Cl I (3 gal)	Cl III	Cl IIIA	Cl VW	Cl VA	Totals
A	17.6T	32.7T		74.8T		125.1T
B	17.6T	32.7T		74.8T		125.1T
C	14.3T	33.5T		79.0T		126.8T
D	18.9T	29.0T		77.7T		125.6T
MCATF Hq	12.0T	28.4T	36.7T	74.0T	37.4T	188.5T
Totals	80.4T	156.3T	36.7T	380.3T	37.4T	691.1T

Table II-4. Mid-Range Regimental MCATF Logistic Vehicle Requirements

Maneuver Element	Cl I	Cl III	Cl IIIA	Cl VW	Cl VA	Total
A	1	2		6		9
B	1	2		6		9
C	1	3		5		9
D	1	2		6		9
MCATF Hq	1	2	3	3	3	12
Totals	5	11	3	27	3	48

(For 6 gal water/man/day, 1 additional log veh is required in each maneuver element.)

Table II-5. Comparison of Unit Train Vehicles to Total Vehicles

Maneuver Elements	Total Vehicles	Train Vehicles	Percent Unit Train Vehicles
A	104	20	19.2
B	104	20	19.2
C	102	21	20.6
D	97	19	19.6
MCATF Hq	97	23	23.7
Totals	504	103	20.4

Table II-6. Mid-Range Helicopter Support Requirements; Regimental Level MCATF

Total Lift Required	Avg CH-53E Lift; 50 NM Radius	Sorties Per Day	Flight Hrs Per Sortie	Total Flt Hrs Per Day	Aircraft Per Day
691.1 T	13.5 T	52	1.4	73	25

Table II-7A. Notional Organization of Three Regimental MCATFs

TASK FORCE ALPHA MCATF; Mid-Range

UNITS	PERS	LVTP-7A1	LVTC-7A1	155(SP)	ADW	8" (SP)	MGOAT Tank	AVLB	[illegible]	[illegible]	TOYs	STINGER	Mortar 81mm	MG 7.62	3 kw	10 kw	30 kw
1st Tk Bn																	
H/S Co Tk Bn	84	5	2						1	5	1				1	1	
Tk Co (2)	128	2					28			30				28			
Rifle Co (2)	240	18								18	4				2		
155(SP) Btry	90	3		6	6				1	15					1	1	
Arty FO Tm	8																
Engr Plt	41	6						1									
FAAD Det	13	2								2		6					
AAV Det	112																
TOTAL	716	36	2	6	6		28	1	2	70	5	6		28	4	2	
2nd Tk Bn																	
H/S Co Tk Bn	84	5	2						1	5	1				1	1	
Tk Co (2)	128	2					28			30				28			
Rifle Co (2)	240	18								18	4				2		
155(SP) Btry	90	3		6	6				1	15					1	1	
Arty FO Tm	8																
Engr Plt	41	6						1									
FAAD Det	13	2								2		6					
AAV Det	112																
TOTAL	716	36	2	6	6		28	1	2	70	5	6		28	4	2	
3rd Bn 6th MPR																	
H/S Co Inf Bn	142	6	2						1	6	1				1	1	
Wpns Co	61	8								8	1		8		1		
Rifle Co (4)	480	36								36	8				4		
155(SP) Btry	90	3		6	6				1	15					1	1	
Arty FO Tm	16																
Engr Plt	41	6						1									
FAAD Det	13	2								2		6					
AAV Det	187																
TOTAL	1030	61	2	6	6			1	2	67	10	6	8		7	2	
Hq Task Force Alpha																	
Hq Co	104	9	4						5	9	2				2	5	
Tk Bn Det	2																
Arty Bn Det	5																
Engr Co Hq	4																
FAAD Det	14	2								2		6					
Arty Bn Hq (155 SP)	97	8	2						2	8					2	1	1
Targ Acq Det	21																
Recon Co	99								11	11							
AAV Bn Det	5																
8" SP Btry	102	3			6	6				9					1	1	
AAV Bn Det	5																
AAV Det	78																
TOTAL	526	22	6		6	6			18	39	2	6			5	7	1
	2988	155	12	18	24	6	56	3	24	246	22	24	8	56	20	13	1

UNIT TRAIN	PERS	LVTP-7A1	LVTC-7A1	LVTR-7A1	M-578	M-88	ATW
MCSSU							
HST	34	1					9
H/S Co	9		1				
Bn AID	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1				2	
AAV	34	1		1			
	139	7	1	1	1	2	9
MCSSU							
HST	34	1					9
H/S Co	9		1				
Bn AID	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1				2	
AAV	34	1		1			
	139	7	1	1	1	2	9
MCSSU							
HST	34	1					9
H/S Co	9		1				
Bn AID	27	4					
Arty	11				1		
Engr	1						
FAAD	1						
AAV	34	1		1			
	110	6	1	1	1		9
MCSSU							
HST	38	2					13
Hq Co	9		1				
Recon	1						
FAAD	1						
MCATF-AID	8	2					
Hq Btry	13	1					
8"(SP)	11	1			1		
AAV	34	1		1			
	115	7	1	1	1		13
	503	27	4	4	4	4	40

Table II-7B. Notional Organization of Three Regimental MCATFs

5th MARINES MCATF; Mid-Range

UNITS	PERS	LVTP-7A1	LVTC-7A1	155(SP)	ADW	M60A1 Tank	AVLB	5/4T HMTT	MG 50 cal	TOW	STINGER	Mortar 81mm	MG 7.58	3 kw	10 kw	30 kw	UNIT TRAIN	PERS	LVTP-7A1	LVTC-7A1	LVTR-7A1	M-578	M-88	[illegible]
1st Bn 5th MAR																	MCSSU							
H/S Co Inf Bn	142	6	2					1	6	1				1	1		HST	41	1					7
Wpns Co	61	8							8	1		8		1			H/S Co	9		1				
Rifle Co (3)	360	27							27	6				3			Bn AID	20	4					
155(SP) Btry	90	3		6	6			1	15					1	1		Arty	11				1		
Arty FO Tm	12																Engr	1						
Tank Co	64	1				14			15				14				FAAD	1						
Engr Plt	41	6					1										Tanks	13	1				1	
FAAD Det	13	2							2		6						AAV	34	1		1			
AAV Det	163																							
TOTAL	946	53	2	6	6	14	1	2	73	8	6	8	14	6	2			130	7	1	1	1	1	7
2nd Bn 5th MAR																	MCSSU							
H/S Co Inf Bn	142	6	2					1	6	1				1	1		HST	41	1					7
Wpns Co	61	8							8	1		8		1			H/S Co	9		1				
Rifle Co (3)	360	27							27	6				3			Bn AID	20	4					
155(SP) Btry	90	3		6	6			1	15					1	1		Arty	11				1		
Arty FO Tm	12																Engr	1						
Tank Co	64	1				14			15				14				FAAD	1						
Engr Plt	41	6					1										Tanks	13	1				1	
FAAD Plt	13	2							2		6						AAV	34	1		1			
AAV Det	163																							
TOTAL	946	53	2	6	6	14	1	2	73	8	6	8	14	6	2			130	7	1	1	1	1	7
3rd Bn 5th MAR																	MCSSU							
H/S Co Inf Bn	142	6	2					1	6	1				1	1		HST	41	1					7
Wpns Co	61	8							8	1		8		1			H/S Co	9		1				
Rifle Co (3)	360	27							27	6				3			Bn AID	20	4					
155(SP) Btry	90	3		6	6			1	15					1	1		Arty	11				1		
Arty FO Tm	12																Engr	1						
Tank Co	64	1				14			15				14				FAAD	1						
Engr Plt	41	6					1										Tanks	13	1				1	
FAAD Det	13	2							2		6						AAV	34	1		1			
AAV Det	163																							
TOTAL	946	53	2	6	6	14	1	2	73	8	6	8	14	6	2			130	7	1	1	1	1	7
Hq 5th MAR-MCATF																	MCSSU							
Hq Co	104	9	4					5	9	2				2	5		HST	38	2					6
Tank Bn Det	2																Hq Co	9	1	1				
Arty Bn Det	5																Recon	1						
Engr Co Hq	4																FAAD	1						
FAAD Det	14	2							2		6						MCATF-AID	8	2					
Arty 155(SP) Hq Btry	97	8	2					2	8					2	1	1	Hq Btry	13	1					
Targ Acq Det	21																Tank Co	13	1				1	
Recon Co	89							11	11								AAV	37	1		1			
Tank Co	64	1				14			15				14											
AAV Det	72																							
TOTAL	472	20	6			14		18	45	7	6		14	4	6	1		120	8	1	1		1	6
	3330	179	12	18	18	56	3	24	264	26	24	24	56	22	12	1		512	29	4	4	3	4	27

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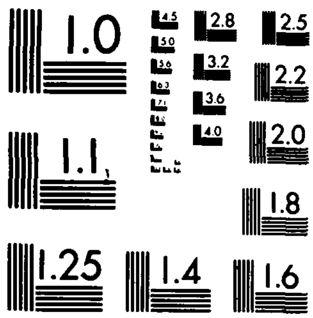

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Table II-7C. Notional Organization of Three Regimental MCATFs

6th MARINES MCATF; Mid-Range

UNIT	PERS	LVTP-7A1	LVTC-7A1	155(SP)	155(T)	8"SP	ADW	M1A1 Tank	AVLB	5/4T HMTT	MG 50 cal	TOW	STINGER	Mortar 81mm	MG 7.62	3 kw	10 kw	30 kw
1st Bn 6th MAR																		
H/S Co Inf Bn	142	6	2							1	6	1				1	1	
Wpns Co	61	8									8	1		8		1		
Rifle Co (3)	360	27									27	6				3		
155(SP) Btry	90	3		6			6			1	15					1	1	
Arty FO Tm	12																	
Tank Co	64	1						14			15				14			
Engr Plt	41	6							1									
FAAD Det	13	2									2		6					
AAV Det	163																	
TOTAL	946	53	2	6			6	14	1	2	73	8	6	8	14	6	2	
2nd Bn 6th MAR																		
H/S Co Inf Bn	142	6	2							1	6	1				1	1	
Wpns Co	61	8									8	1		8		1		
Rifle Co (4)	499	36									36	8				4		
155(T) Btry	101	3			6		12			1	15					1	1	
Arty FO Tm	16																	
Engr Plt	41	6							1									
FAAD Det	13	2									2		6					
AAV Det	187																	
TOTAL	1041	61	2		6		12		1	2	67	10	6	8		7	2	
Hq 6th MAR-MCATF																		
Hq Co	104	9	4							5	9	2				2	5	
Tk Bn Det	2																	
Arty Bn Det	5																	
Engr Co Hq	4																	
FAAD Det	14	2									2		6					
Arty Hq Btry	97	8	2							2	8					2	1	1
Targ Acq Det	21																	
Recon Co	89									11	11							
8"(SP) Btry	94	3				6	6				9							
Tank Co	64	1						14			15				14			
AAV Bn Det	5																	
AAV Det	81																	
TOTAL	540	23	6			6	6	14		18	54	2	6		14	4	6	1
	2567	137	10	6	6	6	22	28	2	24	194	20	18	16	28	17	10	1

UNIT TRAIN	PERS	LVTP-7A1	LVTC-7A1	LVTR-7A1	M-578	M-88	ADW
MCSSU							
HST	32	1					8
H/S Co	9		1				
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
Tank	13	1				1	
AAV	34	1		1			
	121	7	1	1	1	1	8
MCSSU							
HST	32	2					7
H/S Co	9		1				
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
AAV	34	1		1			
	108	7	1	1	1		7
MCSSU							
HST	34	2					12
Hq Co	9		1				
Recon	1						
FAAD	1						
MCATF-AID	8	2					
Hq Btry	14	1					
8" Btry	13	1			1		
Tanks	13	1				1	
AAV	37	1		1			
	131	8	1	1	1	1	12
	360	22	3	3	3	2	27

Table II-8. Three Regimental MCATFs One Day Tonnage Requirements; Mid-Range

MCATF	Cl I	Cl III	Cl IIIA	Cl V	Cl VA	Total
TF-ALPHA	57.7	117.5	36.7	275.5	37.4	524.8
5th Marines	63.0	119.8	36.7	221.9	37.4	478.8
6th Marines	48.5	88.7	36.7	204.7	37.4	416.0
Totals	169.2	326.0	110.1	702.1	112.2	1,419.6

Table II-9. Summary of Mid-Range Logistic Vehicle Requirements for Three Regimental MCATFs

MCATF	Cl I	Cl III	Cl IIIA	Cl V	Cl VA	Total
TF-ALPHA	4	11	3	18	3	39
5th Marines	4	7	2	13	2	28
6th Marines	3	6	3	12	3	27
Totals	11	24	8	43	8	94

Table II-10. Comparison of Mid-Range Unit Train Vehicles to Total Vehicles

MCATF	Total Vehicles	Unit Train Vehicles	Unit Train Percent of Total
TF-ALPHA	380	82	21.5
5th Marines	382	72	18.8
6th Marines	301	60	19.9
Totals	1,063	214	20.1

Table II-11. Mid-Range Helicopter Support Requirement; Three Regimental MCATFs

Total Lift Required	Avg CH-53E Lift; 50 NM Radius	Sorties Per Day	Flight Hrs Per Sortie	Total Flt Hrs Per Day	Aircraft Per Day
1,419.6	13.5 T	106	1.4	148.4	50

Table II-12. MCSSD Task Organization (Mid-Range)

Detachments	Pers	LVTP-7A1	LVTC-7A1	LVTR-7A1	ADW
H/S Bn	12		2		
LS Co	23	1	1		
MAG(VH)	18	1			
Sup Bn	20	2			
Maint Bn	8	1			
Engr Spt Bn	12	1			
Med Bn	23	4			
Mt Bn	90				43
AAV Co	38			1	
Totals	244	10	3	1	43

II-5-4. <u>Planning Factors for Computations of Supply Support Requirements</u>

Requirements for Class I were based on one ration (3 meals) of the Meal Combat, Individual and one intermediate package (3 bars per man) of compressed trioxane fuel per man per day. Water requirements were based on 3 gallons per man and 2 gallons per liquid cooled vehicle per day. Planning factors for Class I and water are shown in table II-13.

Class III fuel requirements were limited to vehicles and the AAH helicopter. Data on hourly fuel consumption were obtained where possible from the U.S. Marine Corps Table of Authorized Materiel (TAM), Revision 6, dated 25 Nov 1980. For vehicles not listed in the TAM, estimated fuel consumption rates were established based upon comparable vehicles. The hours of operations for each vehicle were modified from those contained in the TAM to conform to the tactical operational concepts applicable to maneuver style of warfare. Class III planning factors are listed in table II-14.

Class V ammunition expenditure rates were generally based on Marine Corps Order 8010.1C dated 8 Dec 1978. Expenditure rates for 155mm and 8 inch howitzers were based on the draft study Class VW PLanning Factors, Headquarters, MCDEC dated 1980 after consultation with the Ammunition Branch, Installation and Logistics, Headquarters, U.S. Marine Corps. Expenditure rates for the 25mm automatic gun were obtained from the U.S. Army Infantry School, Ft. Benning, GA, and modified to conform with maneuver warfare tactical concepts. The Chapaarel surface-to-air missile rates were based upon a conceptual armored air defense vehicle with 2 launchers which provided medium range air defense for the MCATF. Class VA rates for the AAH were based on the ordnance capacity of the helicopter, 2 sorties per aircraft per day and complete expenditure of ordnance on each sortie. Class V planning factors for both the long- and mid-range are listed in table II-15.

II-6. CONCLUSIONS AND RECOMMENDATIONS

The tactical, CS, and CSS concepts described above represent realistic goals for the conduct of MCATF operations in the mid-range, and would provide useful interim capabilities while moving to achieve the greater and more desirable capabilities outlined in the long-range concepts.

It is recommended that these concepts be adopted by CG, MCDEC as (1) guidance for POM initiatives to improve MCATF capabilities, and (2) a basis for improving contemporary MCATF concepts, techniques, testing, and evaluation.

Table II-13. Class I Consumption Planning Factors

Rations	4.25# rations per man per day
Trioxane	0.18# trioxane per man per day
Water	24.9# water (3 gallons) per man per day 16.6# water (2 gallons) per liquid cooled vehicle per day

Table II-14. Mid-Range Fuel Consumption Planning Factors by Type Vehicle

Vehicle	Diesel Fuel Requirement (Gal/hr)	Operational Time (Hrs/day)	Fuel Requirement (Gal/day)	Lube Requirement (Gal/day)
M-60A2 Tank	20	6	120	2
LVTP-7A2 Amph Aslt Veh	15	6	90	2
M109A3 155mm SP Arty	15	6	90	2
M110A2 8" SP Arty	15	6	90	2
AVLB Armd Bge Lchr	20	5	100	2
M578 Lt Rcvry Veh	15	5	75	2
M88A1 Hvy Rcvry Veh	20	5	100	2
Dragon Wagon Cargo Veh	10	5	50	1
5/4 T HMTT Truck	4	10	40	1
3 KW Generator	0.6	12	7.2	-
10 KW Generator	3	12	36	1
3KW Generator (Arty)	0.6	20	12	-
10 KW Generator (Arty)	3	20	60	1
30 KW Generator (Arty)	6	20	120	1
AAH Attack Helicopter	150*	3	450*	2

*JP-5

Table II-15. Ammunition Consumption Planning Factors by Type Weapon

Weapon	Rounds/day	Weight/round	Weight/day/weapon
155mm SP Arty	126.84	127.5	16,150.54
8 in SP Arty	89.9	217.2	19,526.28
Mobile rocket launcher	24	1,980	47,520.00
120mm Tank Gun	11.45	71	812.95
105mm Tank Gun	11.45	69	790.05
81mm Mortar	20	18	360.0
TOW Guided Missile	2	89	178.0
Stinger Guided Missile	0.63	47	29.61
Chapaarel S to A msl lchr	2	190	380
25mm Automatic Gun	250	1.67	416.67
50 cal Machine Gun	500	0.395	197.5
Engr Line Charge	1	3,220	3,220
7.62mm Machine Gun	1,000	0.094	94
5.56mm Machine Gun	1,500	0.041	61.5
AAH mixed munitions	2 sorties/day	1,557#/sortie	3,114

For each battalion sized unit a weight of 2,000 pounds was added for rifle ammunition, grenades, explosives, flares, etc.

PART III--POL REQUIREMENTS AND DISTRIBUTION CONCEPTS

III-1. INTRODUCTION

III-1-1. General

Annex B to this report is separately bound as Volume II and contains Class III and Class IIIA requirements based on four MCATF cases. In addition, three alternative systems, consisting of fuel-related equipments, are presented. This section contains an overview of the results obtained in the Annex B analysis.

The MCATF cases and the requirements related thereto are subsets of the MCATF CSS cases and requirements contained in Part I of this report (i.e., related to the long-range period). Case 1 is a regimental MCATF containing four cross-attached maneuver elements; it is the base case in the amphibious mode. Case 2 is also a regimental MCATF containing four maneuver elements; it is the base case in the RDJTF mode which includes establishment of an inland CSSA. Case 3 is representative of deeper penetrations in the RDJTF mode utilizing an MCSSD collocated and protected by one of three regimental level MCATFs. Case 4 is LAAB operating for short durations on the basis of self-sufficiency. A more detailed examination is made, however, with respect to the fuel distribution equipment capabilities that are required not only at the MCATF level, but within the total MAGTF fuel support system that includes support of the MCATF.

III-1-2. Optional Use of Current/Planned Assets

Table III-1 contains analysis results for optional use of current/planned assets for all four MCATF cases. Those assets that are underlined represent the primary distribution means that evolved from the CSS concepts of the Part I (long-range) analysis.

III-2. FUEL SYSTEM ALTERNATIVES

III-2-1. General

There are three sets of POL support system alternatives that reflect incremental increases in support effectiveness.

III-2-2. Alternative A

Alternative A is a set of POL support equipments that is optimized in accordance with the Part I CSS concepts but constrained to those equipments now in the Marine Corps inventory or planned/programmed for procurement. It includes:

a. Amphibious assault fuel system (AAFS).

b. Additional AAFS host and pumping stations for increased storage capability.

Table III-1. Current/Planned Capabilities to Meet Case Requirements

MCATF Cases	Source	Dist'n	Canton-ment/BSA (Storage)	Dist'n	CSSA/ MCSSD (Storage)	Dist'n	MCATF Trains (Storage)	Dist'n	MCATF Veh/AAH (Storage)
Case 1 (MCATF-4ME, AAH Sqdn)	X Amphib Ship Tanks					X Ship-board dispens-ing, Sixcon, 500-gal CD, Helo	X Sixcon, Dragon Wagon, HERS	X Dragon Wagon, Sixcon, Sixcon module pump, HERS	Veh tanks, AAH tanks, 5 gal cans
Case 2 (MCATF-4ME, AAH Sqdn, CSSA with V/STOL facility)	X Amphib Ship Tanks, Tanker Ships, Cargo A/C	X AAFS	X AAFS, TAFDS	X Pipeline, Sixcon, Dragon Wagon	X(CSSA) TAFDS	X Sixcon 500 gal CD, Helo, Dragon Wagon	X Sixcon Dragon Wagon HERS	X Dragon Wagon, Sixcon, Sixcon module pump, HERS	X Veh tanks, AAH tanks, 5 gal cans
Case 3 (MCATF-TF'A', AAH Sqdn, MCSSD)	X Amphib Ship Tanks, Tanker Ships, Cargo A/C	X AAFS	X AAFS, TAFDS	Sixcon, Helo, Dragon Wagon	X(MCSSD) Sixcon, Dragon Wagon	X Sixcon 500 gal CD, Helo, Dragon Wagon	X Sixcon Dragon Wagon, HERS	X Dragon Wagon, Sixcon, Sixcon module pump, HERS	X Veh tanks, AAH tanks, 5 gal cans
Case 4 (LAA Bn)							X 500 gal CD, LAV(L)	X LAV(L), 500 gal CD, HERS Pump	X Veh tanks, 5 gal cans

Legend: Sixcon --Field logistic system (FLS) fuel module. Six fastened with ISO fittings form 8 ft x 8 ft x 20 ft standard container.

AAFS--Amphibious assault fuel system.

TAFDS--Tactical airfield fuel dispensing system.

500 gal CD--500 gallon collapsible drum.

HERS--Helicopter expedient refueling system.

Helo--Transport helicopter, primarily CH-53E.

LAV(L)--Logistic light armored vehicle.

Note: Primary distribution methods are underlined.

c. Additional AAFS hose and pumping stations for pipeline capability to CSSA.

d. Tactical airfield fuel dispensing system (TAFDS).

e. Sixcon fuel module.

f. Sixcon pump module.

g. Helicopter expedient refueling system (HERS), with diesel pump replacing gasoline pump.

h. Additional HERS 500-gallon collapsible drums.

i. Additional HERS pump assemblies.

j. 5-gallon cans.

III-2-3. Alternative B

Alternative B is a set of POL support equipments that is optimized on the Part I CSS concepts but constrained to equipments either current/planned/programmed or available from the other armed forces or available from commercial "off-the-shelf" sources. It includes the same equipments as alternative A, plus vehicle mounted electric pumps to be used in place of the sixcon pump module and the HERS pump assembly on the dragon wagon and LAV(L), saving valuable storage space for more Class III or other supplies.

III-2-4. Alternative C

Alternative C is a set of POL support equipments also optimized in accordance with this study's long-range CSS concepts and unconstrained; that is, the alternative consists of planned/programmed equipments, "off-the-shelf" equipments, and either new conceptual equipment or envisioned product-improved equipment. Alternative C includes:

a. AAFS with product-improved pillow tanks and decontamination monitoring capability.

b. Additional product-improved AAFS 20,000-gallon pillow tanks for additional storage.

c. Additional product-improved AAFS pipeline hose, pipeline pumping stations, and pipeline decontamination monitoring capability relative to the establishment of forward CSSAs.

d. TAFDS with product-improved pillow tanks and decontamination monitoring capability.

e. Product-improved sixcon fuel modules.

f. Sixcon pump modules.

g. Vehicle mounted electric pumps on dragon wagons and LAV(L)s.

h. HERS (with diesel vice gasoline pumps).

i. Additional HERS 500-gallon collapsible drums (CDs).

j. 5-gallon cans.

III-3. POL ANALYSIS FINDINGS

III-3-1. Validation of Sixcon Module Concept

The most significant aspect of the MCATF-related POL support established by the analysis was the validity of using sixcon fuel modules as a primary container system for airlifting fuel and subsequently distributing it at the MCATF level. Analysis revealed that although 500-gallon CDs, when compared individually with sixcon fuel modules, had a 387 percent advantage in "empty weight to payload weight" ratio, that advantage decreased to 15 percent when the lifting restrictions and operational radius constraints of the CH-53E were considered. The analysis results shifted in favor of the sixcon fuel module because of "total system" considerations, i.e., the ease in handling and reduced transfer time which minimize the logistics burden of the MCATF, and the containerization interface with both intra-theater and inter-theater transportation mediums.

III-3-2. Validation of AAFS, TAFDS, and HERS

Challenges arose during the course of the study relative to the utility of AAFS, TAFDS, and HERS in the types of MCATF operations envisioned in the long-range period (i.e., amphibious operations from a seabase and RDJTF operations from a benign cantonment).

Although some host country support and other U.S. service support may evolve in RDJTF commitments, such support cannot be relied upon to the exclusion of traditional Navy/Marine Corps bulk fuel systems. The requirement to unilaterally establish and operate either remote littoral or inland CSSAs in such operations, such as in the MARCORS-5, case 1 standard research scenario, emphasize (rather than detract from) the necessity for maintaining the AAFS and TAFDS capabilities.

Although amphibious operations in the long-range period are envisioned as being normally conducted from a seabase, the requirement to maintain the capability to establish and operate BSAs will still exist, as will the requirement to establish and operate CSSAs in support of both MCATF configured and non-MCATF configured ground and air forces. AAFS, TAFDS, and HERS type systems are and will remain essential to the attainment of these capabilities.

III-3-3. POL Development Goals

Long range development goals for the POL distribution system are contained in alternative C, paragraph III-2-4.

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CONCEPTS FOR COMBAT SUPPORT AND SERVICE SUPPORT TO A MECHANIZED COMBINED ARMS TASK FORCE IN THE *MID- AND LONG-RANGE TIME FRAMES*

VOLUME II

ANNEX B - POL REQUIREMENTS AND DISTRIBUTION CONCEPTS

APRIL 1983

ANNEX B

POL REQUIREMENTS AND DISTRIBUTION CONCEPTS

Table of Contents

Table of Contents (Cont'd)

List of Figures

Table of Contents (Cont'd)

List of Figures (Cont'd)

List of Tables

Table of Contents (Cont'd)

List of Tables (Cont'd)

Appendices

ANNEX B

POL REQUIREMENTS AND DISTRIBUTION CONCEPTS

1. INTRODUCTION

1.1 Purpose.

The purpose of this annex is to identify the quantities and types of POL required to support mechanized combined arms task force (MCATF) operations during the long range period discussed in the basic report; determine the desired fuel system characteristics needed for MCATF support; evaluate the capability of current and planned Marine Corps POL equipment to provide required support; identify equipment available commercially or from other services; develop concepts for equipment not currently available; and then formulate and evaluate conceptual systems utilizing various combinations of currently available, commercial and other services, and conceptual equipment.

1.2 Background.

Volume I of this report contains the development of overall concepts for combat support and combat service support of the mechanized combined arms task force (MCATF). These concepts became the premise for the development of the POL requirements and distribution concepts contained herein. A synopsis of the applicable volume I concepts are repeated in this paragraph to provide a clear and convenient transition for the reader. Combat Support (CS) and Combat Service Support (CSS) concepts are inevitably linked to the tactical concepts or techniques of ground maneuver elements. Contemporary tactical concepts and techniques for the MCATF are evolving through phased testing and evaluation at the Marine Corps Air Ground Combat Center (MCAGCC). These concepts and techniques are recorded in evaluation reports and in Operational Handbook (OH) 9-3, Mechanized Combined Arms Task Forces (MCATF). The current edition of the handbook, Revision A, March 1980, was used as a basic reference for this study.

Tactical concepts and techniques for the long range period were derived from evaluation of contemporary concepts, a series of studies and analyses recently performed by PGRG, PGRG seminars, a general review of the literature, and from principles enunciated in the Marine Corps Long Range Plan (MLRP). The derived tactical concepts focus on a "maneuver style of warfare" in the long range period. This style of warfare is distinctly different from its alleged antithesis: "firepower--attrition." In paragraph 1.2.1 below, an explanation of this style of warfare is provided as a basis for the CSS concepts that follow.

CSS concepts related to MCATFs are also influenced by the size of the MCATF, and its mode of tactical employment, i.e., amphibious or nonamphibious. For this study, two basic sizes of MCATFs were used as representative of Marine Corps contingency tasking. One is a regimental MCATF containing four battalion level maneuver elements. This MCATF uses the mechanized assets of

one division in either an amphibious or nonamphibious operation. The second size of MCATF is representative of Rapid Deployment Joint Task Force (RDJTF) commitments wherein the Marine Corps provides a one-division MAF and up to three additional brigades related to the Maritime Prepositioning Ship (MPS) concept. Each of these brigades, the equivalent of an Army mechanized brigade, is considered to be another regimental MCATF. For purposes of this study a total force containing three regimental MCATFs was selected as the second size of MCATF. Figure B-1 portrays this level MCATF capability configured for nonamphibious warfare representative of a composite MAF (in theater) about Alert Day +35.

1.2.1 Tactical concepts--the MCATF and a maneuver style of warfare.

As this is written, the term "maneuver warfare" is highly visible in contemporary professional publications. However, there is no general consensus on exactly what maneuver warfare is nor what it means to the U.S. Marine Corps and the MCATF. Over the past two years, PGRG has reviewed all pertinent literature on the subject with special focus on contemporary writings in The Marine Corps Gazette. While the articles continue to appear--and to differ on some aspects and implications of maneuver warfare--some basic perceptions, particularly applicable to Marine Corps mechanized operations, can be formulated. Specifically it is suggested that a maneuver style of warfare will be applicable to MCATF tactical concepts and that it will be a unique style, a style evolved by Marines, a style that will suit Marine Corps MCATF operations in both the amphibious and nonamphibious mode. The concept fundamentals of this style are addressed in Operational Handbook (OH) 9-3 (Rev A), March 1980, Mechanized Combined Arms Task Forces (MCATF), and in Education Center Publication (ECP) 9-5, Marine Amphibious Brigade Mechanized and Countermechanized Operations, 20 January 1981. Table B-1 depicts the concept fundamentals as contained in OH 9-3 (Rev A); Table B-2 depicts reinforcing extracts from ECP 9-5.

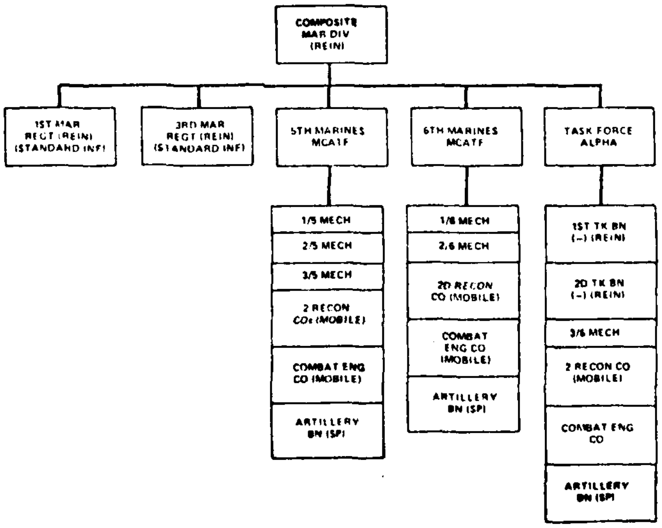

Figure B-1. Representative RDJTF Commitment Containing Three Regimental Level MCATFs

Table B-1. Fundamentals of the Maneuver Style of Warfare

OH 9-3 (Rev A)

202. CONCEPTS

In many situations, MCATFs will be outnumbered and outgunned. An attrition contest, relying on firepower, is not likely to bring a positive result. Therefore, MCATFs must be prepared to USE MANEUVER WARFARE. Commanders are responsible for understanding the concepts of maneuver war and applying them on the battlefield.

Maneuver warfare is an overall STYLE OF WARFARE. It seeks to DISLOCATE, DISRUPT and DISORIENT the opponent, DESTROYING HIS COHESION, rather than destroying him piece-by-piece with firepower. In maneuver war, the MCATF seeks to create SUCCESSIVE UNEXPECTED and THREATENING situations for the opponent. The opponent should be brought to see his situation NOT JUST AS UNFAVORABLE OR DETERIORATING; he must see it as DETERIORATING AT AN EVER-INCREASING PACE.

Maneuver warfare uses both fire and maneuver. However, in general, fire is used TO CREATE FAVORABLE CONDITIONS FOR MANEUVER and to ANNIHILATE UNITS WHOSE COHESION HAS BEEN SHATTERED, not to engage cohesive enemy units head-on in an attrition contest.

Tactics emphasize RESPONDING RAPIDLY TO FLEETING OPPORTUNITIES TO THROW STRENGTH AGAINST WEAKNESS. Attacks seek gaps in enemy positions and pour reserves through them, rolling out behind the enemy to encircle him. Defenses place only a "tripwire" forward to absorb the enemy's attention, destroying him by counter-attacks into his flanks as he penetrates.

Tactics are RECON-PULL, not COMMAND-PUSH. The POINT OF MAIN EFFORT and THE AXIS OF ADVANCE shift continuously in response to opportunities. Therefore, MISSION-TYPE ORDERS ARE A REQUIREMENT. Subordinate unit commanders act on their own initiative within the COMMANDER's INTENT.

Table B-2. Fundamentals of the Maneuver Style of Warfare

ECP 9-5
BASIC PRINCIPLES
". . .
A. The primary objective of the force employed must be the destruction of the enemy's combat effectiveness. . . .
B. The enemy must be continuously exposed to the full combined array of our weapons and potential threats. Stereotyped operations must be avoided with emphasis on flexibility. . . . The commander must orient on the enemy rather than terrain. . . .
C. . . . . The battlefield of the future will reward the side maintaining the initiative, flexibility, and freedom of maneuver."

Confirmation of these principles as guiding tactical concepts in the long range period is contained in the draft MLRP. In summary, the fundamentals of the MCATF tactical concept derived from the three references (the draft MLRP, OH 9-3A, and ECP 9-5) are as follows:

- The MCATF is omnidirectional with maneuver elements separated on the battlefield.
- There is no forward edge of the battle area (FEBA) per se.
- There is no secure rear area immediately "behind" the MCATF nor any secure main supply route (MSR).
- There is normally no beach support area (BSA) in the amphibious mode.
- Equal or compatible mobility and survivability is required for all systems and equipment on the MCATF battlefield.
- There is a confirmed definitional trend and focus: Mechanized Combined Arms Task Force.

Integration of tanks and amphibious assault vehicles (AAVs) into the maneuver elements of the MCATF is only the first step in evolving combined arms tactics and techniques. Although there is no official definition of combined arms in JCS Pub 1, it is generally accepted that combined arms involves attacking an enemy with two or more weapons systems simultaneously in such a manner that any action the enemy takes to avoid or minimize the effect of one system makes him more vulnerable to another.

In warfare with both sides reflecting these fundamentals, the concept of "penetration" as in a penetration of enemy positions, is not very useful. The separated maneuver elements of a MCATF may often be intermingled with enemy elements. When terrain no longer defines basic objectives, most of the operational area becomes a "no man's land" with value only to support the presence or passage of forces, as the ocean supports a fleet. Penetration distances as used in this study are conceived as distances of reach or projection into this "no man's land" from relatively secure bases either afloat or ashore.

1.2.2 Combat service support concepts.

In the preceding paragraphs MCATF tactical concepts were defined and collectively serve as a basis for designing the long range combat service support (CSS) concepts. In the area of supply support, self sufficiency, single circuit, concatenate loops, and concurrent centroidal elliptical support concepts were considered for both the amphibious and nonamphibious mode, and for each of the two differently sized MCATFs. In addition to the CSS concepts related to MCATF operations, it was agreed that the study group would examine CSS implications of the introduction of the Light Armored Assault Battalion (LAAB) represented by the Light Armored Vehicle (LAV) family development. This analytic excursion was designed to determine if introduction of the LAAB into Marine divisions would generate any unusual CSS implications or supply requirements. As this report is written, the Marine Corps organization and concept of employment for the LAAB is preliminary (not firm). Current literature indicates that the LAAB may be employed as a maneuver battalion in either RDJTF operations as part of a nonamphibious MPS brigade, or in amphibious forcible entry operations. It is further indicated that the battalion could also be used in a combat support role. Assuming the trend toward combined arms prevails, the study group envisions that the battalion will evolve in the long range period as a maneuver element, primarily inserted and extracted by helicopter for relatively short (less than 36 hours) missions involving "hit and run" tactics. Therefore, it is believed that the appropriate supply support concept is <u>prima facia</u>, self-sufficiency.

Primary MCATF organizational focus has been placed on a semi-permanently organized, regimental sized MCATF. The regimental level MCATF is notionalized with four battalion level maneuver elements and a headquarters element; it serves as a base case for designing the concepts and distribution systems, and for determining requirements in both the amphibious and nonamphibious mode. A diagram of the base regimental MCATF is shown in figure B-2. Note that there are five basic distribution cells, each with an organic unit train. Note also that there is no mobile combat service support detachment (MCSSD) in the base case, i.e., no large, MCATF level train.

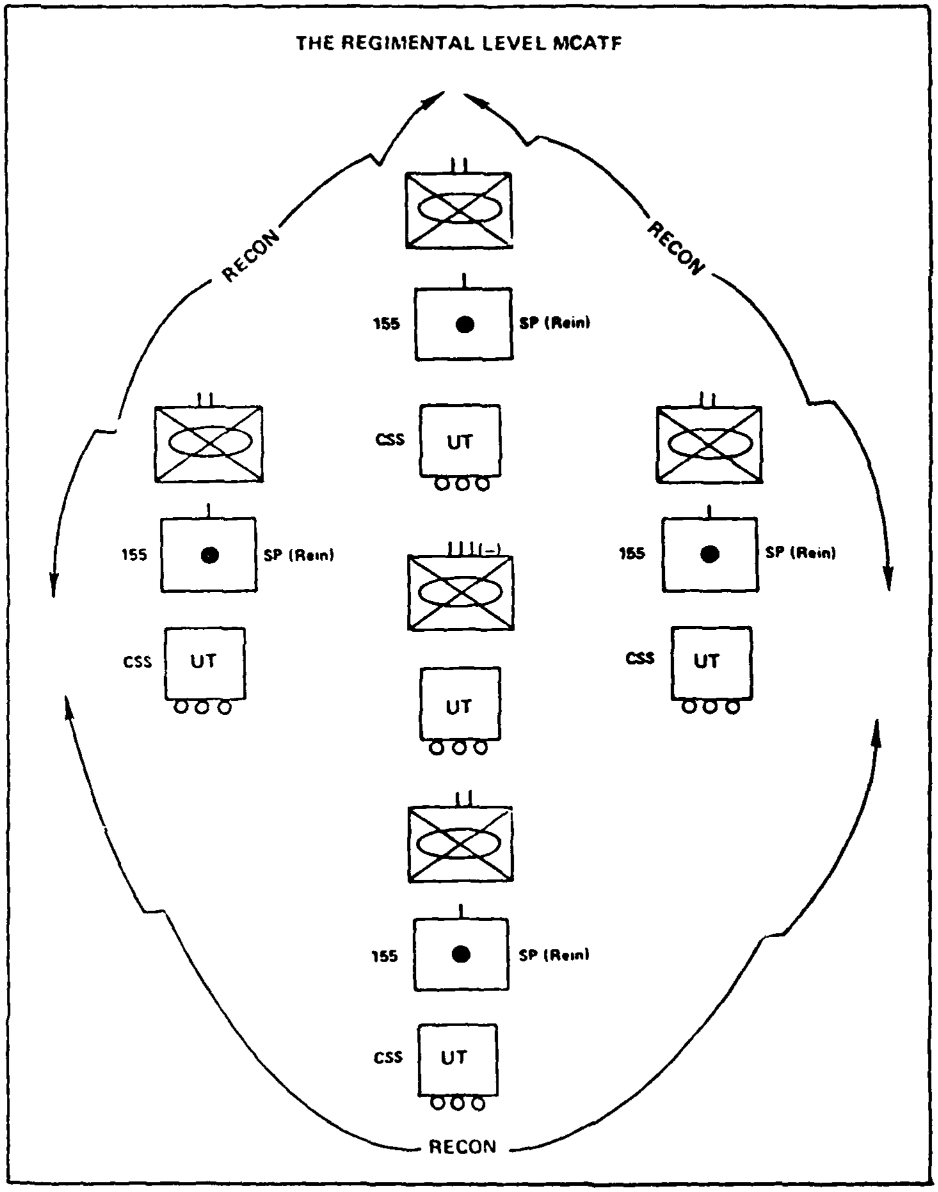

Figure B-2. Diagram of the Regimental Level MCATF

1.2.2.1 Basic concepts.

Two basic concepts hve been developed, one for amphibious operations and one for RDJTF operations involving a benign landing in a secure cantonment/basing area with tactical operations relatively deep inland. These concepts are specifically designed to support the tactical concepts set forth in paragraph 1.2.1 and are described as follows:

- Single circuit support of amphibious operations: This concept is focused on sea-based support with unit distribution direct to MCATF unit trains by helicopter. It assumes that the Navy has sea control and limited air superiority; the antiship missile threat has been neutralized; and support ships will remain in the amphibious objective area (AOA). Although a supply push system could be used for some operations, a Demand-Pull system is normally required. This primary concept is the most responsive support concept that is feasible for landing force MCATFs employing a maneuver style of warfare ashore. There is no BSA envisioned and it is noted that this major change in technique is confirmed in the MLRP. This concept implies a major technological effort to facilitate the close coordination required in all ship-to-MCATF interfaces. It focuses on highly responsive, selective unloading throughout the amphibious operation (vice transition to general unloading). It could involve new ship design; it must involve packaging loads, storage of loads aboard ship, selective and responsive inventory location and control through computers, selective and responsive movement of loads to helo spots, expeditious "hook up/pick up", and expeditious transition handling at the MCATF unit trains. It must be capable in almost all weather conditions. Figure B-3 shows a general diagram of the distribution elements related to contemporary shipping. In situations where total helicopter lifted resupply direct from ships is not fully feasible (extreme weather, tactical situation, or helo sortie insufficiency), alternative resupply techniques are envisioned. These techniques are situationally dependent, and could include:

  (1) Landing craft air cushion (LCAC) ship-to-shore (landing site); escorted convoy to unit trains.

  (2) LCAC ship-to-shore; dump as cache for later pickup by escorted or unescorted elements of unit trains.

  (3) LCAC ship-to-shore rendezvous site to meet escorted or unescorted elements of unit trains.

  (4) Establishment of a BSA, including the associated security force and the protected ground or helicopter transportation resources required to deliver supplies to the unit trains of the MCATF maneuver elements. The BSA would be located in terrain that is accessible by LCAC and defendable with minimum ground forces.

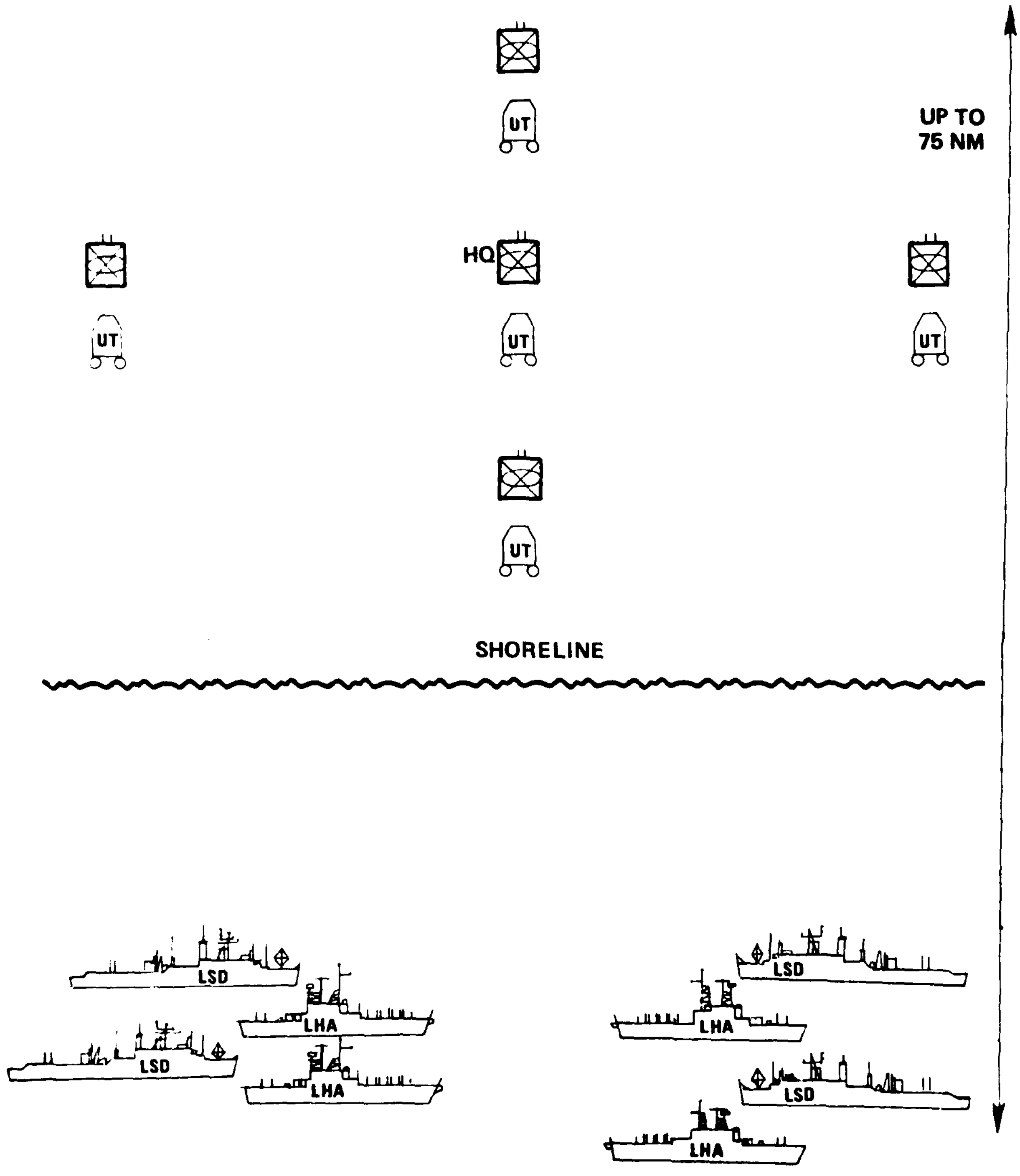

Figure B-3. General Diagram of Distribution Elements Related to Contemporary Amphibious Shipping

- Support of RDJTF commitments (benign landing, secure cantonment/ basing area, operations inland):

  Supply support is from a cantonment area direct to unit trains by helicopter where possible. It is the same single circuit concept as the amphibious operation, except it is land based. However, there is a high probability that the operational area is too far from a cantonment/basing area to permit direct support to the unit trains. Also there is a high probability that a relatively secure area extends some distance inland from the cantonment/base area. Therefore, the more common concept would be to establish semifixed forward CSS areas (CSSAs) some distance inland, like those envisioned in the MARCORS-5 Case 1 scenario (35 miles inland). In such cases, this concatenate concept includes establishment and maintenance of sufficient stocks (e.g., 3-5 days of supply) at the CSSAs primarily by surface means, with helicopter lift direct to the unit trains from the CSSAs. Due to the estimate of a 75 NM (139 km) limit for effective and responsive helicopter supportability (see volume I), the forward CSSAs should be located no farther than 75 NM from the furthest unit to be supported.

1.2.2.2 MCATF size related to penetration distance and concurrent centroidal-elliptical concepts.

As indicated in the preceding paragraph, the supply support concepts of the base case regimental MCATF are limited as follows:

- Sea-based, direct to maneuver element (ME) trains, amphibious mode-75 NM penetration from sea-based support.

- Cantonment based, direct to ME trains, RDJTF mode--75 NM penetration.

- Cantonment based, CSSA link, RDJTF mode--75 NM penetration from the CSSA.

It was also determined that the penetration distance of the base case MCATF could not be extended by the addition of an MCSSD which would be required to operate without mobile security forces in an unsecure area or "no man's land." This is simply illustrated in figure B-4.

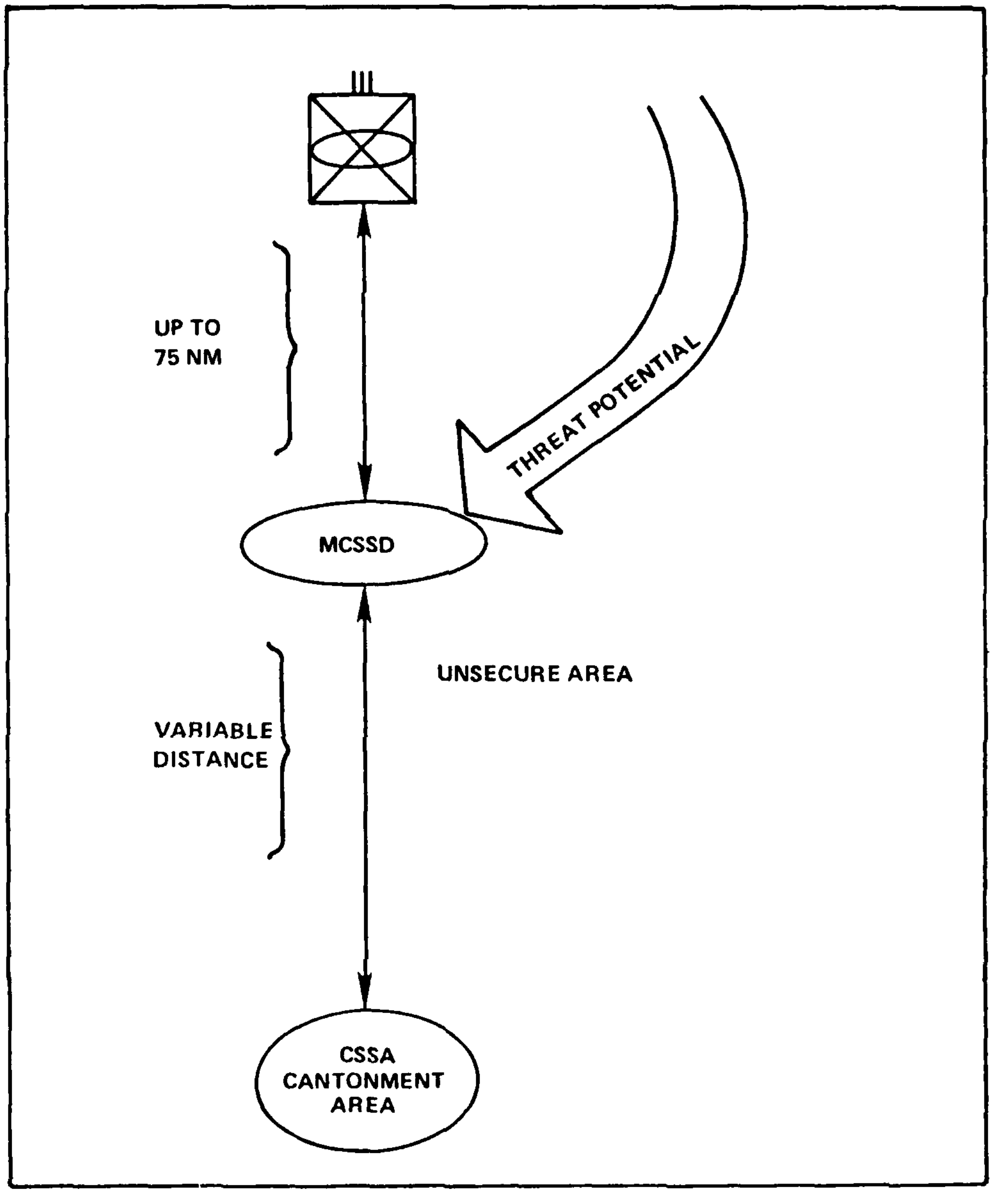

Figure B-4. Illustration of MCSSD Vulnerability

However, in nonamphibious RJDTF operations wherein the total force includes three regimental MCATFs, deeper tactical projections appear possible. Assuming the operational area extends inland along a major corridor and the threat becomes proportionately greater with distance penetrated, a concurrent centroidal-elliptical support system could be used with MCSSDs collocated and protected by one or two regimental MCATFs. Figures B-5 and B-6 are illustrative of this concept. Therefore, a maximum projection of a force containing three regimental level MCATFs may be initially estimated to be 225 NM from a secure cantonment area. It should be noted that independent Marine Corps projections of this depth are highly theoretical and situationally dependent. It is also noted that such penetration involves unconstrained CSS and helicopter assets.

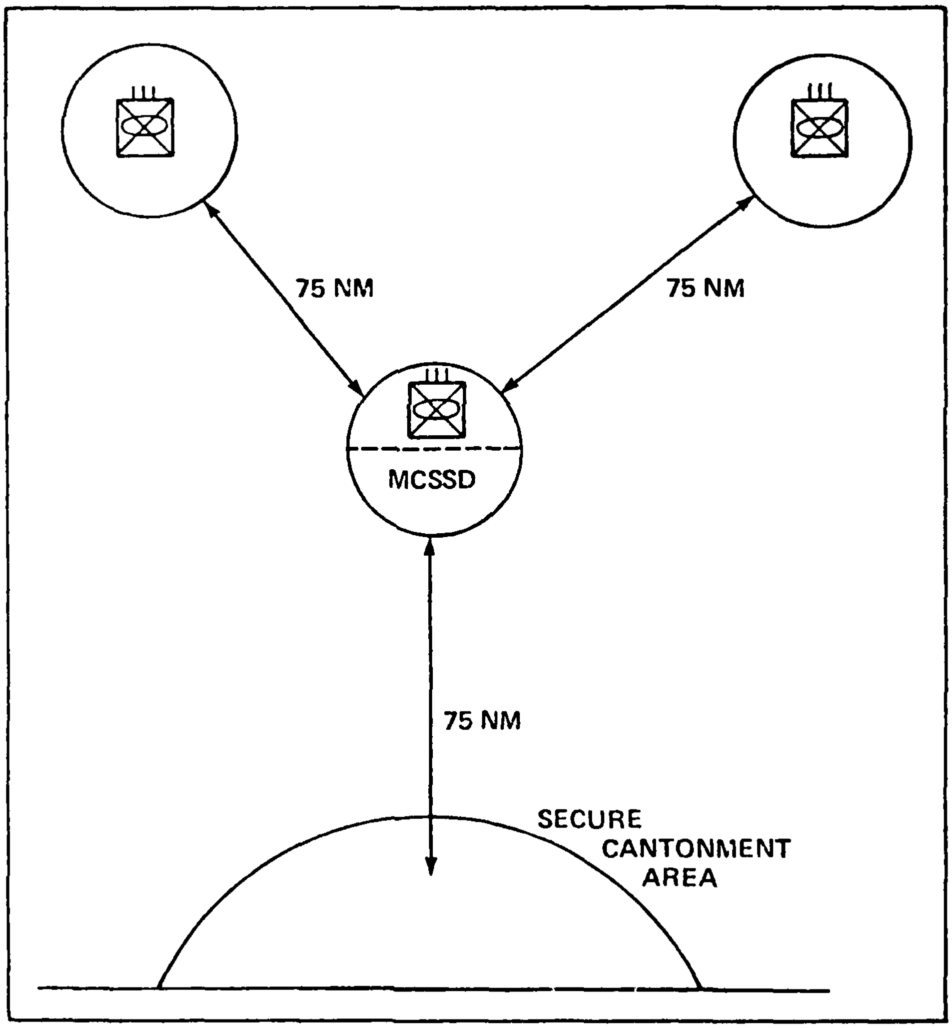

Figure B-5. Example of 150 NM Penetration

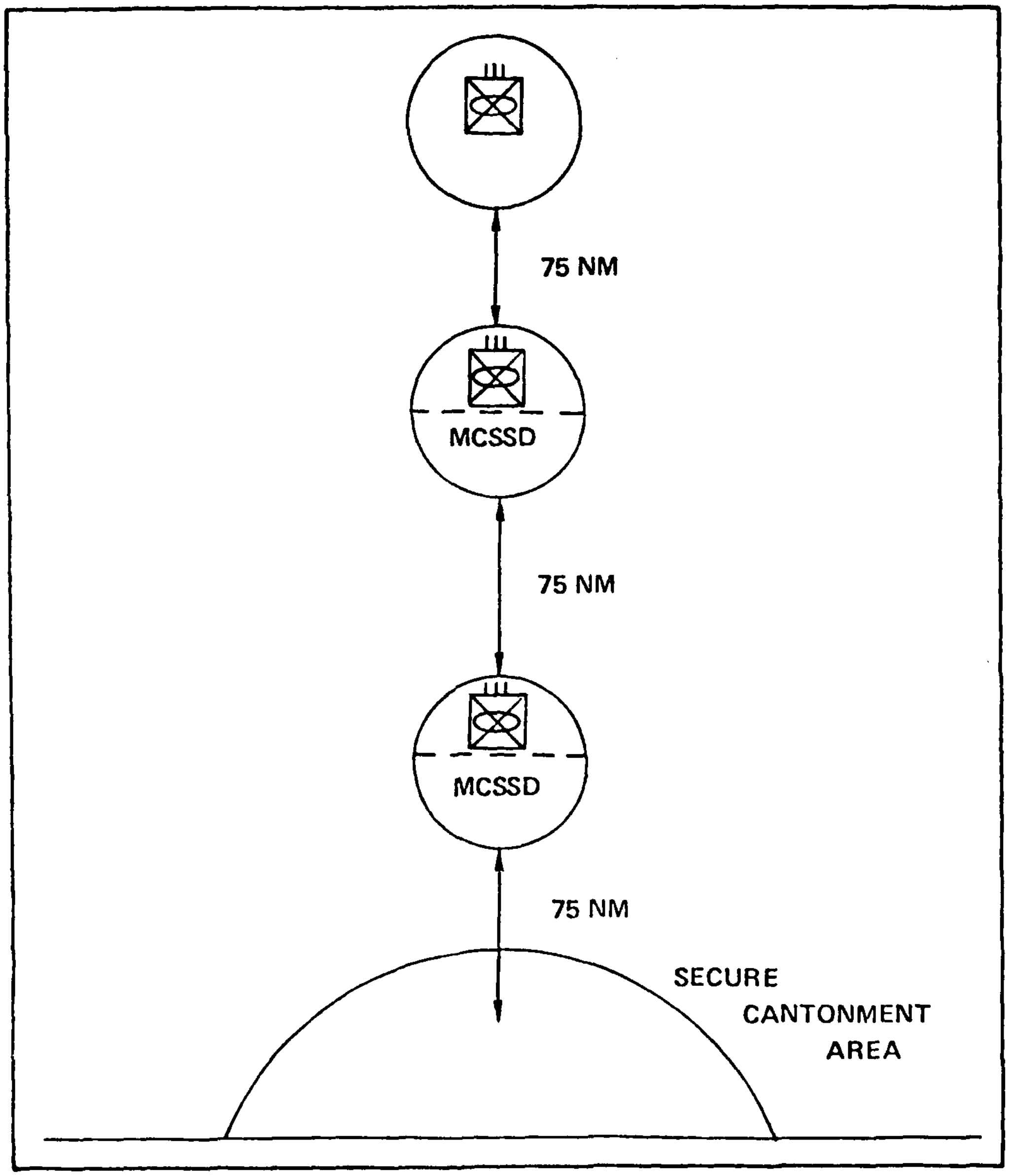

Figure B-6. Theoretical Maximum Penetration

1.2.2.3 Concept amplification and distribution system.

The base regimental level MCATF will be used to provide amplification of the basic concepts and a description of the distribution system. The four maneuver elements and the MCATF headquarters element carry in their organic vehicles one day of Class I, one day of water, the prescribed load of Class V (which varies with weapon system and vehicle size), and the prescribed load of Class III (10 to 50 gallons in 5 gallon cans). The unit train for each of the four maneuver elements and the MCATF headquarters element carries one day of Class I, III, and V, a tailored allowance of critical spare parts (Class IX), and one day of water (normally 3 gallons per man). In addition, the unit trains of the MCATF headquarters element and one selected maneuver element will provide refueling/rearming capability for attack helicopters (i.e., one day of Class IIIA and Class VA for an helicopter attack (HMA) squadron). This unit trains concept is designed to provide a one day of supply "buffer" with each maneuver element that is replenished daily by transport helicopter on a demand-pull basis, thereby minimizing the size of the trains and fully exploiting the maneuver capabilities of the MCATF. Delivery to the unit trains will be at selected times and locations depending on the tactical situation as applicable to the maneuver elements, aviation elements, and supporting logistic element. Coordination and assignment of priorities will be effected by the MCATF commander and his staff.

In addition to minimal size, unit trains should be:

- As mobile as the combat units so that tactical maneuver is not restricted.
- Adequately armed and armored (protected) so that diversion of combat power is not routinely required for unit train protection.
- Capable of receiving resupply and replenishing combat units <u>rapidly</u> with minimal impact on tactical operations.

The unit trains will be replenished from the sea bases, CSSA or cantonment area as applicable, normally by helicopter. Current estimates are that approximately 1,028 tons of Class I, III, III(A), V, and V(A) replenishment supplies will be needed to provide for one day of representative consumption for the regimental MCATF. It is noted that Class I requirements would essentially remain constant while the demand-pull for Classes III, III(A), V, and V(A) would vary significantly. When MCATF movement is greatest, Class III requirements would be high and Class V requirements low. Conversely, where there is a major engagement, Class V requirements would be high and Class III requirements low. Thus, the daily consumption of these classes would almost always have a wide variance.

Replenishment of the elements by the unit trains will probably take place during the period from late afternoon to early morning although it could take place at any time on an urgent requirement exists. All Class I, III and V supplies, and water in 5-gallon containers are envisioned to be transported in

unit trains on 22½-ton, 8x8 "dragon wagons," an articulated tractor-trailer unit with high mobility and survivability characteristics. Each dragon wagon would be equipped with a hydraulic crane for handling cargo, including fuel containers. All supplies would be delivered to the unit trains in field logistic system (FLS) containers. At a time and location, an appropriate number of dragon wagons transporting the required maneuver element supplies will take the supplies to the using organization at a rendezvous point. After replenishment the dragon wagons will return to the "trains area." Quantities of supplies would be consolidated on the fewest number of vehicles, new replenishment requirements would be determined, and the additional quantities and types of supplies needed would be transmitted by the trains' logistic support commander to the logistic activity designated to coordinate control of the distribution.

1.3 Approach.

The basic approach used for this analysis is to first quantify fuel storage and distribution requirements for four MCATF/CSS combination cases. These cases as shown in table B-3 include:

Case 1. A regimental size MCATF with four maneuver elements (MCATF-4ME) supported from a seabase. This MCATF is formed from the tank, assault amphibious vehicle (AAV), infantry, and self-propelled artillery resources of a Marine division. There are three infantry heavy MEs and a balanced tank-infantry ME in this MCATF.

Case 2. Same as case 1 except the MCATF is supported from a cantonment/BSA and a combat service support area (CSSA).

Case 3. A regimental size MCATF supported from a cantonment/BSA and a mobile combat service support detachment (MCSSD) collocated with another MCATF operating closer to the cantonment/BSA area. This force is a representative slice from a three regimental MCATF that could be formed from the tank, AAV, and self-propelled artillery resources of one Marine division and up to three maritime prepositioned ship (MPS) brigades. Task Force ALPHA (TF-ALPHA) MCATF, as presented earlier in figure B-1, plus an MCSSD with one day of supply designed to support that MCATF, is used to size this case. This MCATF includes two balanced tank-infantry MEs and one infantry-heavy ME.

Case 4. A battalion size MCATF consisting of a light armored assault battalion (LAAB) equipped to be self-sufficient for a short term, independent mission, i.e., no resupply during the mission.

Table B-3. Maneuver Element/Support Cases

	Case 1	Case 2	Case 3	Case 4
Maneuver element (includes unit train)	MCATF-4ME	MCATF-4ME	TF-ALPHA	LAAB
Self-sufficient				X
CSSA Support		X		
MCSSD Support			X	
Cantonment Support		X	X	
Shipboard support	X			

Following the quantification of fuel requirements and a discussion of desired fuel system characteristics, the current and planned Marine Corps fuel storage and distribution systems are identified and described. An evaluation of these systems is then conducted to determine support capabilities and potential limitations. Next, alternative fuel storage and distribution systems and concepts are identified and then evaluated in various combinations with current and planned systems to identify potential methods for overcoming any current and planned system limitations. Study findings are summarized as the final element of the analysis.

2. FUEL REQUIREMENTS

2.1 General.

This section identifies the fuel consumption and distribution requirements of the various MCATF elements which encompass the range of combat forces and support concepts to be evaluated. The fuel consumption demand of the three type maneuver elements considered--MCATF-4ME, TF-ALPHA, and LAAB--together with their unit trains, when applicable, are presented first. This is followed by the requirements for a CSSA and a MCSSD. The implications of these demands on cantonment and shipboard fuel capabilities are assessed as a final consideration related to requirements.

2.2 Maneuver element requirements.

2.2.1 MCATF-4ME.

The combat force depicted is a regimental size MCATF with four maneuver elements and a MCATF headquarters. This MCATF requirement provides the basis for the case 1 and case 2 analyses. As noted from the detailed listing of personnel, vehicles and weapons shown in table B-4, there are three infantry-heavy MEs (A, B, and D) and a balanced tank-infantry ME (C) in this MCATF.

Table B-4. Regimental MCATF--Long Range

	PERS	LVTX-P	LVTX-C	LVTX-E	LAV	LAV (C)	AVLB	155SP	AMMO VEH	MLRS	TANK	LAV (AD)	MG 5.56	MG 7.62	25mm	MG 50 cal	TOW	STINGER	81mm
ME-A																			
H/S Co, Inf Bn	142	4	2										8	4	4		1		
Wpns Co	61	8											16	8	8		1		8
Rifle COs (3)	360	27											54	27	27		6		
Arty Btry 155(SP)	93	3						8	8	3			6	3	3	16			
Arty FO Tm	12																		
Tank Co	64	1									14		2	15	1	14			
Engr Plt	41			6			1												
FAAD Det	13	2											4	2	2			6	
AAV Co(-)	139																		
	925	45	2	6			1	8	8	3	14		90	59	45	30	8	6	8
ME-B																			
H/S Co, Inf Bn	142	4	2										8	4	4		1		
Wpns Co	61	8											16	8	8		1		8
Rifle COs (3)	360	27											54	27	27		6		
Arty Btry 155(SP)	93	3						8	8	3			6	3	3	16			
Arty FO Tm	12																		
Tank Co	64	1									14		2	15	1	14			
Engr Plt	41			6			1												
FAAD	13	2											4	2	2			6	
AAV Co(-)	139																		
	925	45	2	6			1	8	8	3	14		90	59	45	30	8	6	8
ME-C																			
H/S Co, Tk Bn	84	3	2										6	3	3		1		
Tank COs (2)	128	2									28		4	30	2	28			
Rifle COs (2)	240	18											36	18	18		4		
Arty Btry 155(SP)	93	3						8	8	3			6	3	3	16			
Arty FO Tm	8																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2	2			6	
AAV Co(-)	88																		
	695	28	2	6			1	8	8	3	28		66	56	28	44	5	6	
ME-D																			
H/S Co, Inf Bn	142	4	2										8	4	4		1		
Wpns Co	61	8											16	8	8		1		8
Rifle COs (4)	480	36											72	36	36		8		
Arty Btry 155(SP)	93	3						8	8	3			6	3	3	16			
Arty FO Tm	16																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2	2			6	
AAV Co(-)	154																		
	1,010	53	2	6			1	8	8	3			109	53	53	16	10	6	8
MCATF Hq																			
Hq Co	104	9	4										18	9	9		2		
Tank Bn Det	2																		
Arty Bn Det	5																		
Engr Co Hq	4																		
FAAD Det	14	2											4	2	2			6	
Arty Hq Btry	97	8	2										16	8	8				
Targ Acq	21																		
MPL Bty Hq	8																		
Tank Co	64	1									14		2	15	1	14			
MAD Plt	38											6							
Recon Co	105				16	5								16	16				
Div Recon Co	105				16	5								16	16				
AA Bn Det	5																		
AAV Co(-)	72																		
	644	20	6		32	19					14	6	40	66	52	14	2	6	
	4,199	191	14	24	32	10	4	32	32	12	70	6	382	293	223	134	33	30	24

Unit Trains	PERS	LVTX-P	LVTX-R	LVTX-C	M-578	M-88	40W
MCSSU							
HST	54	1					16
H/S Co	9			1			
Bn Aid	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
Tanks	13	1				1	
AAV Det	34	1	1				
	143	7	1	1	1	1	16
MCSSU							
HST	54	1					16
H/S Co	9			1			
Bn Aid	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
Tanks	13	1				1	
AAV Det	34	1	1				
	143	7	1	1	1	1	16
MCSSU							
HST	52	1					16
H/S Co	9			1			
Bn Aid	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1					
AAV Det	34	1	1			2	
	158	7	1	1	1	2	16
MCSSU							
HST	50	2					14
H/S Co	9			1			
Bn Aid	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
AAV Det	34	1	1				
	126	7	1	1	1		14
MCSSU							
HST	67	2		1			
Hq Co	9	1					
Tank Co	13	1				1	11
MAD	2						
Recon	1						
Div Recon	1						
FAAD	1						
MCATFAIO	8	2					
Hq Btry	13	1					
AAV Det	31	1	1				
	141	8	1	1		1	11
	711	36	5	5	4	5	77

LVTX-P--Landing vehicle tracked, experimental personnel carrier
LVTX-C--LVTX, command/communication
LVTX-E--LVTX, engineer
LVTX-R--LVTX, recovery
LAV--Light armored vehicle
LAV(C)--LAV, command/communication
LAV(AD)--LAV, air defense
AVLB--Armored vehicle launched bridge
M-578--Recovery vehicle, full tracked, light, armored
M-88--Recovery vehicle, full tracked

Based on the structure outlined in table B-4 the daily fuel requirements were developed for each MCATF maneuver element. These requirements are summarized in table B-5. Supporting sub-tables B-5A through B-5E provide a detailed listing of daily fuel consumption for each maneuver element in terms of the type and number of vehicles in the basic maneuver element, as well as its supporting unit train. Total fuel requirements also include representative requirements for an attack helicopter squadron that would be operating with the MCATF and its related requirement of up to two mobile forward area refueling and rearming facilities. Fuel consumption planning data used to develop these and other type MCATF requirements are identified in table B-6.

Table B-5. Class III/IIIA Requirement, MCATF-4ME (Gallons/Day (GPD))

	Class III		Class IIIA	
Element	GPD Diesel	GPD Lube	GPD JP-5	GPD Lube
ME-A	10,429	212		
ME-B	10,429	212		
ME-C	11,183	208		
ME-D	8,765	196		
MCATF Hq	8,774	161	10,800	48
Total	49,580	989	10,800	48

Table B-5A. Class III/IIIA Requirement, MCATF-4ME
Maneuver Element-A

Basic Maneuver Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	45	4,050	90
LVTX-C	2	180	4
LVTX-E	6	540	12
AVLB	1	100	2
ESPAWS	8	720	16
Ammo Veh	8	600	16
MLRS	3	270	6
M-1 Tank	14	2,184	28
		8,644	174

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	7	630	14
LVTX-C	1	90	2
LVTX-R	1	90	2
M-578	1	75	2
M-88	1	100	2
Dragon Wagon	16	800	16
		1,785	38

Total Maneuver Element

GPD Diesel	GPD Lube
10,429	212

Table B-5B. Class III/IIIA Requirement, MCATF-4ME Maneuver Element-B

Basic Maneuver Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	45	4,050	90
LVTX-C	2	180	4
LVTX-E	6	540	12
AVLB	1	100	2
ESPAWS	8	720	16
Ammo Veh	8	600	16
MLRS	3	270	6
M-1 Tank	14	2,184	28
		8,644	174

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	7	630	14
LVTX-C	1	90	2
LVTX-R	1	90	2
M-578	1	75	2
M-88	1	100	2
Dragon Wagon	16	800	16
		1,785	38

Total Maneuver Element

GPD Diesel	GPD Lube
10,429	212

Table B-5C. Class III/IIIA Requirements, MCATF-4ME Maneuver Element-C

Basic Maneuver Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	28	2,520	56
LVTX-C	2	180	4
LVTX-E	6	540	12
AVLB	1	100	2
ESPAWS	8	720	16
Ammo Veh	8	600	16
MLRS	3	270	6
M-1 Tank	28	4,368	56
		9,298	168

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	7	630	14
LVTX-C	1	90	2
LVTX-R	1	90	2
M-578	1	75	2
M-88	2	200	4
Dragon Wagon	16	800	16
		1,885	40

Total Maneuver Element

GPD Diesel	GPD Lube
11,183	208

Table B-5D. Class III/IIIA Requirement, MCATF-4ME
Maneuver Element-D

Basic Maneuver Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	53	4,770	106
LVTX-C	2	180	4
LVTX-E	6	540	12
AVLB	1	100	2
ESPAWS	8	720	16
Ammo Veh	8	600	16
MLRS	3	270	6
		7,180	162

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	7	630	14
LVTX-C	1	90	2
LVTX-R	1	90	2
M-578	1	75	2
Dragon Wagon	14	700	14
		1,585	34

Total Maneuver Element

GPD Diesel	GPD Lube
8,765	196

Table B-5E. Class III/IIIA Requirement, MCATF-4ME

MCATF Headquarters

Basic Headquarters Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	20	1,800	40
LVTX-C	6	540	12
LAV	32	1,920	32
LAV-C	10	600	10
LAV(AD)	6	180	6
M-1 Tank	14	2,184	28
		7,224	128

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	8	720	16
LVTX-C	1	90	2
LVTX-R	1	90	2
M-88	1	100	2
Dragon Wagon	11	550	11
		1,550	33

Attack Helicopter Squadron

Type Aircraft	No. Aircraft	GPD JP-5	GPD Lube
AAH	24	10,800	48

Total Headquarters

Class III		Class IIIA	
GPD Diesel	GPD Lube	GPD JP-5	GPD Lube
8,774	161	10,800	48

Table B-6. Fuel Consumption Planning Data

Vehicle[1]	Gal/Hr	Hrs/Day	Gal/Day	Lube Gal/Day
LVTX-( )	15	6	90	2
LAV	6	10	60	1
AVLB	20	5	100	2
ESPAWS	15	6	90	2
Ammo Veh	15	5	75	2
MLRS	15	6	90	2
M-1 Tank	26	6	156	2
LAV (AD)	6	5	30	1
M-578	15	5	75	2
M-88	20	5	100	2
Dragon Wagon	10	5	50	1
AAH	150	3	450	2

NOTE 1:

	LVTX-( )	Landing vehicle tracked experimental
	LAV	Light armored vehicle
	AVLB	Assault vehicle launched bridge
	ESPAWS	155mm Howitzer, self-propelled
	MLRS	Multiple launcher rocket system
	M-1	Tank, 120mm
	LAV (AD)	Mobile air defense vehicle (conceptual)
	M-578	Light recovery vehicle
	M-88	Heavy recovery vehicle
	AAH	Advanced attack helicopter

2.2.2 Task Force ALPHA.

This MCATF is a representative slice of a three regimental MCATF force. It provides the basic combat force for the case 3 analysis. Table B-7 lists the personnel, vehicles, and weapons used to form the MCATF.

Table B-7. Task Force ALPHA MCATF

UNIT	PERS	LVTX-P	LVTX-C	LVTX-E	LAV	LAV (C)	AVLB	155SP	AMMO VEH	MLRS	TANK	LAV (AD)	MG 5.56	MG 7.62	MG 50 cal	25mm	TOW	STINGER	81mm
1st Tank Bn																			
H/S Co Tk Bn	84	5	2										10	5		5	1		
Tank Co (2)	128	2									28		4	30	28	2			
Rifle Co (2)	240	18											36	18		18	4		
155(SP) Btry	93	3						8	8	3			6	3	16	3			
Arty FO Tm	8																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2		2		6	
AAV Det	94																		
	701	30	2	6			1	8	8	3	28		60	53	44	30	5	6	
2nd Tank Bn																			
H/S Co Tk Bn	84	5	2										10	5		5	1		
Tank Co (2)	128	2									28		4	30	28	2			
Rifle Co (2)	240	18											36	18		18	4		
155(SP) Btry	93	3						8	8	3			6	3	16	3			
Arty FO Tm	8																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2		2		6	
AAV Det	94																		
	701	30	2	6			1	8	8	3	28		60	53	44	30	5	6	
3rd Bn 6th Mar																			
H/S Co Inf Bn	142	6	2										12	5		6	1		
Wpns Co	61	8											16	8		8	1		8
Rifle Co (4)	480	36											72	36		36	8		
155(SP) Btry	93	3						8	8	3			6	3	16	3			
Arty FO Tm	16																		
Engr Plt	41			6			1												
FAAD Det	13	2											4	2		2		6	
AAV Det	170																		
	1,016	55	2	6			1	8	8	3			110	55	16	55	10	6	8
Hq Task Force ALFA																			
Hq Co	104	9	4										8	4		4	2		
Tank Bn Det	2																		
Arty Bn Det	5																		
Engr Co Hq	4																		
FAAD Det	14	2											4	2		2		6	
Arty Hq Btry	97	8	2										16	8		8			
Targ Acq Det	21																		
MLR Btry Hq	8																		
MAD Plt	38											6							
Recon Co	105				16	5								16		16			
Div Recon Co	105				16	5								16		16			
AAV Bn Det	5																		
AAV Det	70																		
	578	19	6		32	10						6	28	46		46	2	6	
	2,996	134	12	18	32	10	3	24	24	9	56	6	253	217	104	161	22	24	8

UNIT TRAIN	PERS	LVTX-P	LVTX-R	LVTX-C	M-578	M-88	ADW
MCSSU (1st Tank Bn)							
HST	52	1					16
H/S Co	9			1			
Bn AID	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1				2	
AAV	37	1	1				
	159	7	1	1	1	2	16
MCSSU (2nd Tank Bn)							
HST	52	1					16
H/S Co	9			1			
Bn AID	18	4					
Arty	11				1		
Engr	1						
FAAD	1						
Rifle Co	4						
Tank	26	1				2	
AAV	37	1	1				
	159	7	1	1	1	2	16
MCSSU (3rd Bn 6th Mar)							
HST	50	2					15
H/S Co	9			1			
Bn AID	20	4					
Arty	11				1		
Engr	1						
FAAD	1						
AAV	37	1	1				
	129	7	1	1	1		15
MCSSU (Hq Task Force ALFA)							
HST	56	2					10
Hq Co	9	1		1			
MAD	12						
Recon Co	1						
Div Recon	1						
FAAD	1						
MCATF-AID	8	2					
Hq Btry	13	1					
AAV	39	1	1				
	140	7	1	1			10
	587	28	4	4	3	4	57

LVTX-P--Landing vehicle tracked, experimental personnel carrier
LVTX-C--LVTX, command/communication
LVTX-E--LVTX, engineer
LVTX-R--LVTX, recovery

LAV--Light armored vehicle
LAV(C)--LAV, command/communication
LAV(AD)--LAV, air defense

AVLB--Armored vehicle launched bridge
M-578--Recovery vehicle, full tracked, light, armored
M-88--Recovery vehicle, full tracked

The daily fuel requirements for Task Force ALPHA were developed in the same basic manner as MCATF-4ME. Total MCATF requirements for Task Force ALPHA are summarized in table B-8. Those organizations listed in the "Element" column are the primary organizations around which the maneuver elements are built. Supporting sub-tables B-8A through B-8D provide detailed unit consumption data.

Table B-8. Class III/IIIA Requirement TF-ALPHA (Gallons/Day)

	Class III		Class IIIA	
Element	GPD Diesel	GPD Lube	GPD JP-5	GPD Lube
1st Tk Bn	11,363	212		
2nd Tk Bn	11,363	212		
3rd Bn, 6th Mar	8,995	201		
MCATF Hq	6,260	126	10,800	48
Total	37,981	751	10,800	48

Table B-8A. Class III/IIIA Requirement TF-ALPHA
1st Tank Battalion

Basic Maneuver Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	30	2,700	60
LVTX-C	2	180	4
LVTX-E	6	540	12
AVLB	1	100	2
ESPAWS	8	720	16
Ammo Veh	8	600	16
MLRS	3	270	6
M-1 Tank	28	4,368	56
		9,478	172

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	7	630	14
LVTX-C	1	90	2
LVTX-R	1	90	2
M-578	1	75	2
M 88	2	200	4
Dragon Wagon	16	800	16
		1,885	40

Total Maneuver Element

GPD Diesel	GPD Lube
11,363	212

Table B-8B. Class III/IIIA Requirement TF-ALPHA
2nd Tank Battalion

Basic Maneuver Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	30	2,700	60
LVTX-C	2	180	4
LVTX-E	6	540	12
AVLB	1	100	2
ESPAWS	8	720	16
Ammo Veh	8	600	16
MLRS	3	270	6
M-1 Tank	28	4,368	56
		9,478	172

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	7	630	14
LVTX-C	1	90	2
LVTX-R	1	90	2
M-578	1	75	2
M-88	2	200	4
Dragon Wagon	16	800	16
		1,885	40

Total Maneuver Element

GPD Diesel	GPD Lube
11,363	212

Table B-8C. Class III/IIIA Requirement TF-ALPHA
3rd Battalion 6th Marines

Basic Maneuver Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	55	4,950	110
LVTX-C	2	180	4
LVTX-E	6	540	12
AVLB	1	100	2
ESPAWS	8	720	16
Ammo Veh	8	600	16
MLRS	3	270	6
		7,360	166

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	7	630	14
LVTX-C	1	90	2
LVTX-R	1	90	2
M-578	1	75	2
Dragon Wagon	15	750	15
		1,635	35

Total Maneuver Element

GPD Diesel	GPD Lube
8,995	201

Table B-8D. Class III/IIIA Requirement TF-ALPHA
MCATF Headquarters

Basic Maneuver Element

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	19	1,710	38
LVTX-C	6	540	12
LAV	32	1,920	32
LAV-C	10	600	10
LAV (AD)	6	180	6
		4,950	98

Unit Train

Type Veh	No. Veh	GPD Diesel	GPD Lube
LVTX-P	7	630	14
LVTX-C	1	90	2
LVTX-R	1	90	2
Dragon Wagon	10	500	10
		1,310	28

Attack Helicopter Squadron

Type Aircraft	No. Aircraft	GPD JP-5	GPD Lube
AAH	24	10,800	48

Total Headquarters

Class III		Class IIIA	
GPD Diesel	GPD Lube	GPD JP-5	GPD Lube
6,260	126	10,800	48

2.2.3 Light armored assault battalion.

The third type MCATF, used to size the combat force requirement for case 4, is a LAAB equipped to be self-sufficient for a short term independent mission with no resupply during the mission. The personnel and vehicles of this battalion structure are shown in table B-9.

The daily fuel consumption for the 145 LAVs in this battalion is 8,700 gallons of diesel fuel and 145 gallons of lube oil. This consumption is based on the planning factors for a LAV set forth in table B-6 which established a usage criteria of 60 gals/day of diesel and 1 gal/day of lubricating oil for each LAV.

Table B-9. Light Armored Assault Battalion Organization[1/]

Unit	Pers	LAV(LA)	LAV(AG)	LAV(AT)	LAV(C)	LAV(AD)	LAV(M)	LAV(R)	LAV(L)	Total LAVs
H&S Co	130	4			8			2	16	30
Wpns Co	211	6		15		10	8	1		40
A Co (LAA)	164	15	9					1		25
B Co (LAA)	164	15	9					1		25
C Co (LAA)	164	15	9					1		25
	833	55	27	15	8	10	8	6	16	145

Note 1: LAV Variants

LA--Light assault
AG--Assault gun
AT--Antitank
C --Command
AD--Air defense
M --Mortar
R --Recovery
L --Logistics

2.3 CSSA requirements.

As discussed in the basic report a combat service support area is a facility established between a cantonment area and the maneuvering MCATFs to improve the responsiveness of combat service support. It is semi-fixed (i.e., not mobile) and exists in a secure area that is an extension of the secure area of the cantonment/BSA. The representative CSSA developed for this study is one based on maintaining a five day level of supply for a supported MCATF with four maneuver elements, providing an expeditionary V/STOL facility capable of supporting six AV-8-type aircraft, and providing resources needed for the internal operation of the CSSA.

The total fuel storage requirement for the CSSA based on the above criteria is shown in table B-10.

Table B-10. CSSA Fuel Storage Requirement

(5 day level of supply)

Unit	Class III Diesel (gal)	Class IIIA JP-5 (gal)
MCATF-4ME	247,900	54,000
V/STOL Facility		70,000
CSSA	33,385	
Total	281,285	124,000

The fuel storage requirement for the supported MCATF is based on the daily consumption data presented in table B-6 earlier. The JP-5 requirement for the V/STOL facility is based on 6 AV-8 aircraft, each flying 4 sorties per day from the facility at a consumption rate of 4,000 pounds per sortie. The requirements for CSSA internal operations are detailed in table B-11. They are based on a representative CSSA developed in Volume I of this report.

Table B-11. Daily CSSA Internal Fuel Requirements

Type Veh	No. Veh	Gal/day/veh	Total GPD (Diesel)
HMTT/MRC-83	7	40	280
HMTT/MRC-109	6	40	240
HMTT/Fire Trk	5	40	200
HMTT 5/4T	37	40	1,480
Dragon Wagon	20	50	1,000
Forklift 10,000 lb.	30*	72	2,160
Forklift 6,000 lb.	6	36	216
Crane, 30T	15**	72	1,080
Gen. 30KW, 60 Hz	4	3	12
Gen. 30KW, 400 Hz	3	3	9
Gen. 3KW, 60 Hz	5	0.6	3
Gen. 10KW, 60 Hz	1	3	3
Welding Machine	2	60	120
Floodlight set	24	1.5	36
TAFDS	3***	3.5	11
			6,850

NOTES: *Six 10,000 lb forklifts are dedicated to Class III support, seven to Class IIIA.

**Four 30 ton cranes are dedicated to Class III support, two to Class IIIA.

***One TAFDS for Class III, one TAFDS for Class IIIA, and one TAFDS for water.

2.4 MCSSD requirement.

The MCSSD is a mobile combat service support detachment organized to carry one day of supply for a MCATF. It is envisioned as normally operating to the rear of a supported MCATF in company with another MCATF whose combat forces would provide security for the MCSSD. The representative organization for an MCSSD used for this study is shown in table B-12. The structure of this detachment is based on the vehicles and personnel required to carry the supplies for a Task Force ALPHA-type MCATF discussed earlier, plus those necessary for its internal operation.

Table B-12. Representative MCSSD Organization

		Vehicles			
Detachments	Pers.	LVTX-P	LVTX-C	LVTX-R	Dragon Wagon
H/S Bn	12		2		
LS Co	23	1	1		
MAG (VH)	18	1			
Sup Bn	20	2			
Maint Bn	8	1			
Engr Spt Bn	12	1			
Med Bn	23	4			
MT Bn	124				61
AAV Co	38			1	
	278	10	3	1	61*

NOTE: *Ten dragon wagons are dedicated to haul Class III, three to haul Class IIIA.

The fuel storage requirements for the MCSSD are shown in table B-13. These requirements reflect the usage of the supported task force ALPHA plus the MCSSD's organic vehicles.

Table B-13. MCSSD Fuel Storage Requirements (Gallons)

Unit	Class III Diesel (gal)	Class IIIA JP-5 (gal)
TF-ALPHA	37,981	10,800
MCSSD[1/]	4,310	
	42,291	10,800

Note 1:	14 LVTX x 90 GPD =	1,260
	61 Dragon Wagons x 50 GPD =	3,050
		4,310

2.5 Cantonment area requirements.

A cantonment area, as used herein, is a built-up, ground support base facility, whose functions include the provision of combat service support to a MAGTF. The term is normally associated with RDJTF operations and may include a seaport or airport facility. The cantonment area is normally the location of reserve bulk fuel storage for the entire MAGTF (e.g., MAF). A notable exception is when elements of the Marine aircraft wing (MAW) are operating from remote theater airfields with separate sources of bulk fuel.

The determination of complete quantitative fuel requirements for a MAF is beyond the scope of this study, focus being limited to the impact of the MCATF and maneuver warfare tactics. The cantonment area would normally include, however, a 10 day level of fuel to support the MCATF and its related V/STOL facility. This 10 day requirement for the MCATF-4ME supported by a CSSA (Case 2 of paragraph 1.5) is shown in table B-14. Similar data for the MCATF-TF ALPHA supported by an MCSSD (Case 3 of paragraph 1.5) is shown in table B-15.

Table B-14. Partial Cantonment Fuel Storage Requirement*, MCATF-4ME and CSSA (10 days of supply)

Unit	Class III Diesel (gal)	Class IIIA JP-5 (gal)
MCATF-4ME	495,800	108,000
V/STOL Facility		140,000
CSSA Equipment	66,770	
Total	562,570	248,000

*Does not include requirements of refueling vehicles and transport helicopters providing CSS support to CSSA and to MCATF, or other ground and aviation equipment requirements of the MAF not directly identified with the MCATF-4ME.

Table B-15. Partial Cantonment Fuel Storage Requirement*, MCATF-TF Alpha and MCSSD (10 days of supply)

Unit	Class III Diesel (gal)	Class IIIA JP-5 (gal)
MCATF-TF ALPHA	379,810	108,000
MCSSD Equipment		140,000
Total	379,810	248,000

*Does not include requirements of transport helicopters providing CSS support to MCATF and to MCSSD, or other ground and aviation equipment requirements of the MAF.

2.6 Shipboard requirements.

As addressed in the basic report, the Marine Corps Long Range Plan (MLRP) sets forth a concept for supporting MCATF operations from a logistics base established aboard ships in the amphibious objective area (AOA). Fuel storage (Class III and IIIA) is envisioned as being accomplished in a combination of amphibious and tanker ships, the latter being commercial ships most of the time. Fuel would be transferred by underway refueling operations from the tanker ships to the amphibious ships. Fuel would then be dispensed into containers aboard the amphibious ships and distributed to the MCATF configured landing force ashore by helicopter. The "seabase" would normally provide a 10 day level of both Class III and Class IIIA.

The applicable case for seabase support is Case 1 (see paragraph 1.5), in which the MCATF-4ME is supported directly from ships by helicopter; there is no MCSSD, no CSSA, and no cantonment. As previously mentioned, the determination of complete quantitative fuel system requirements for a MAF is beyond the scope of this study. However, shipboard storage facilities would include, in addition to others, the quantities shown in table B-16, for Case 1.

Table B-16. Partial Shipboard Fuel Storage Requirement*, MCATF-4ME (10 days of supply)

Class III Diesel (gal)	Class IIIA JP-5 (gal)
495,800	108,000

*Does not include requirements of transport helicopters providing CSS support to MCATF-4ME, or other ground and aviation equipment requirements of the MAF not directly identified with the MCATF-4ME.

3. DESIRED FUEL SYSTEM CHARACTERISTICS FOR MCATF SUPPORT

3.1 General.

As demonstrated in volume I and the first section of this report, CSS concepts are tailored to fit MCATF operational concepts/tactics/employment techniques and their related combat support. Likewise, the POL support system must be tailored to fit the MCATF CSS concepts. In that context this section identifies the generic fuel system characteristics desired when matching the MCATF CSS concepts with the quantitative fuel requirements contained in section 2. Desired MCATF-related fuel system characteristics are included for the overall fuel system, the unit trains, the CSSA, the MCSSD, the cantonment/BSA, and shipboard support. The reader should note that fuel system evaluation and results are not contained in this section. These follow later commencing with section 5.

3.2 Overall fuel system characteristics for MCATF support.

In general, the POL system should be flexible enough to support the range of MCATF support requirements with a minimum of "special situation" equipments. Ideally, the basic components of the system should be used in different combinations to satisfy all requirements, not only those related to MCATF support but also those related to the support of non-MCATF ground, aviation, and logistic operations. Overall MCATF-related CSS system characteristics that bear heavily on desired POL system design are:

- Emphasis on small unit trains at the maneuver element level and MCATF headquarters level, and elimination of the MCATF level train (MCSSD) except in those cases where a large MAF with several regimental size MCATFs is employed.
- Emphasis on helicopter resupply of the unit trains (and the MCSSD when one exists).
- Emphasis on the supplying of maneuver element vehicles and attack helicopters by train vehicles through daily rendezvous (i.e., service station concept).
- Establishment of semifixed cantonments/BSAs and CSSAs when the situation permits (i.e., normally when a benign or secure area exists, as in a RDJTF operation, and an extended land campaign with deep penetrations is conducted).
- Emphasis on ground resupply of CSSAs when established.

Two major desired fuel system characteristics that evolve directly from the above CSS system characteristics are that:

- Helicopter and truck liftable/compatible containerized storage and transfer means are desired for providing mobile POL support forward to the MCATF unit trains and to the MCATF MCSSD when one exists.

- Bulk storage and transfer means are desired from the sea forward to cantonment/BSAs and CSSAs in situations where they exist.

A more detailed breakdown of desired storage and transfer means for the four MCATF support cases under consideration are shown in table B-17. Desired fuel system characteristics specifically related to the unit trains, CSSA, MCSSD, cantonment/BSA, and shipboard support are given in subsequent paragraphs.

3.3 Unit train desired characteristics.

The maneuver element unit trains should each have the capacity for mobile storage/transport of one day of class III (diesel) for the maneuver element. The MCATF headquarters unit train must have one day of class III for the headquarters and one day of class IIIA for the supporting attack helicopter squadron. The mobility capability, particularly cross country capability, should be at least equal to that of the maneuver element combat vehicles. The unit train should have material handling equipment (MHE) for transferring fuel containers on and off of the train vehicles used for fuel transport/storage. Ideally the fuel transport/storage vehicle should have this MHE as an organic part of the vehicle. It is also highly desirable that the same fuel container be utilized throughout the train's fueling mission, from the receipt of the full fuel container at the transport helicopter-fuel transport/storage vehicle rendezvous until completion of pumping the fuel from that same container to a combat vehicle or an attack helicopter at the combat vehicle-fuel transport/storage vehicle rendezvous or the attack helicopter-fuel transport/storage vehicle rendezvous. Intermediate transfer of fuel from one type of container to another should be avoided. In addition, different types of containers and different types of pumps should be minimized for ease in maintenance.

The desired class III pumping capability, under the unit train method of operation described above, is then influenced primarily by the "refueling plan" or "refueling standing operating procedure (SOP)" adopted by the maneuver element commander for refueling operations at the combat vehicle-fuel transport/storage vehicle rendezvous. As envisioned in the tactical concepts developed (and as presently practiced), maneuver element companies (from 15 to 20 AAVs and tanks) would proceed to an assembly area and from there dispatch platoons (3 to 5 vehicles) to a rendezvous position with a fuel transport/storage vehicle from the train. To assure tactical dispersion, only one or two combat vehicles would take on fuel at a time from a transport/ storage vehicle. A 100 GPM pump that provides both single and dual nozzle capability would provide the best flow rate and refueling procedure match-up with the types of combat vehicles that will be utilized in the MCATF. A 50 GPM pump with a single nozzle would also be satisfactory.

The desired class IIIA pumping capability is also influenced primarily by the unit train-attack helicopter refueling SOP. Again, to assure tactical dispersion, only one or two attack helicopters would normally take on fuel from a transport/storage vehicle of the train. The attack helicopters have a fuel system that is adaptable to either pressure or open port refueling. Therefore, both closed-circuit and open port nozzles should be provided in the system. The same 100 GPM capability available for ground combat vehicle

Table B-17. Desired Fuel System Storage and Transfer Means

	Source	Transfer Means	Intermediate Storage	Transfer Means	Intermediate Storage	Transfer Means	Intermediate Storage	Transfer Means	User
Case 1	Ship (Bulk storage. Transfer to containers. Container storage)					Helo lift (Container transfer)	ME trains (Mobile storage of containers on log vehs)	Log veh lift. Dispense from containers to user.	ME Vehs, AAHs
Case 2	Ship, host country, or U.S. Army (Bulk storage)	Hose/pipeline (Bulk transfer)	Cantonment/ BSA (Bulk storage)	Large veh tanker (Bulk transfer)	CSSA (Bulk storage. Transfer to containers. Container storage)	Helo lift (Container transfer)	ME trains (Mobile storage of containers on log vehs)	Log veh lift. Dispense from containers to user	ME Vehs, AAHs
Case 3	Ship, host country, or U.S. Army (Bulk storage)	Hose/pipeline (Bulk transfer)	Cantonment/BSA (Bulk storage. Transfer to containers. Container storage)	Helo lift (Container transfer)	MCSSD (Mobile storage of containers on log vehs)	Helo lift (Container transfer)	ME trains (Mobile storage of containers on log vehs)	Log veh lift. Dispense from containers to user	ME Vehs, AAHs
Case 4							LAAB train (Mobile storage of containers on log vehs)	LAV log veh lift. Dispense from containers to user.	LAAB Vehs

LEGEND: AAHs - Advanced Attack Helicopters
BSA - Beach Support Area
CSSA - Combat Service Support Area
LAAB - Light Armored Assault Battalion
LAV - Light Assault Vehicle
Log - Logistic
MCSSD - Mobile Combat Service Support Detachment
ME - Maneuver Element
Vehs - Vehicles

refueling operations would also satisfactorily match the receiving flow rate requirements of the attack helicopter. However, a 50 GPM pump with single nozzle outlet would only be marginally satisfactory from the viewpoint of "out of action" time.

3.4 CSSA desired characteristics

A storage capacity for five days of supply of class III (diesel) and class IIIA (JP-5) is desired in the CSSA. Since the CSSA envisioned herein is semi-fixed (i.e., capable of being broken down and transported but not mobile) and is located in a landward extension of the cantonment/BSA secure area, bulk fuel "farms" with maximum capacity and minimum real estate requirements are desired. Since the estimated daily fuel resupply requirement to the CSSA is moderate (56,000 GPD diesel and 25,000 GPD JP-5, case 2), receipt capability for delivery primarily by ground transportation appears most desirable. Although theoretically an unlimited nozzle flow rate from the tanker and an unlimited tank farm receiving flow rate is desired, a limitation is recognized because of practical hose size and pillow tank pressure constraints associated with any expeditionary "tank farm" system. The 200 GPM range appears practical provided several receiving stations are established. Receipt capabilities are also desired for pipeline delivery, since the RDJTF environment significantly raises the probability of pipeline availability either through the host country or through the U.S. Army. Receipt capability for delivery by C-130, C-141, or C-5A tanker configured aircraft is also desirable, but applicable situations are less likely. As previously mentioned, since there is "no man's land" between the CSSA and the supported MCATF, and since the movement of the maneuver elements (each with its own train) is omnidirectional vice unidirectional, the desirable primary delivery means from the CSSA to the maneuver element trains is by helicopter. Therefore, multiple dispensing stations for filling containers adjacent to helicopter pickup/staging points are desired.

3.5 MCSSD desired characteristics.

Desirable fuel system characteristics for the MCSSD are similar to those related to the unit trains. Since the MCSSD moves with a MCATF it should have fuel transport/storage vehicles with a mobility capability equivalent to the MCATF combat vehicles. Since the MCSSD's primary fuel-related function is to provide a "wholesale" one day of supply buffer of both Class III and Class IIIA for the unit trains, which will be received and transferred by helicopter, the most significant desirable system characteristic is that the fuel be prepackaged in containers that are helicopter-fuel transport/storage vehicle compatible and which have a low empty weight/payload weight ratio.

MHE within the MCSSD is required for lifting fuel containers onto and off of the MCSSD transport/storage vehicles. Placement directly by helicopter (particularly the CH-53E) is not desirable because of the hazardous high speed debris created by the helicopter blades and the static electricity problem (i.e., the helicopter must be grounded while hovering). To assure availability and desirable high mobility characteristics, ideally the MHE would be an organic part of the fuel transport/storage vehicle.

The MCSSD fuel transport/storage vehicle should have a secondary, "retail" capability of dispensing fuel to MCSSD vehicles, combat vehicles, and helicopters as required. In addition, the fuel transport/storage vehicle should be capable of one for one replacement with unit train vehicles in an emergency. It is, therefore, desirable that the MCSSD fuel transport/storage vehicle be identical to that used in the unit trains.

3.6 Cantonment/BSA desired characteristics.

Desirable fuel-related storage, receiving, and distribution characteristics within the cantonment area are the same as those associated with the current BSA; i.e., capability to receive fuel by flexible hose from ships, aircraft, vehicles, or from various types of containers, capability to store 10 days of supply, and the capability to dispense directly to vehicles, aircraft, or containers. However, additional fuel storage capability (both diesel and JP-5) is desired to meet the increased requirements for operating and supporting the MCATF. In addition the following cantonment/BSA-related POL system characteristics are desirable:

- An increased capability to transfer bulk fuel forward to MCATF-supporting CSSAs, with delivery by large capacity tanker vehicles being preferred and distribution by host country or U.S. Army provided pipeline a possibility.

- An increase in material handling, marshalling, and inventory control capabilities related to a quantum increase in the number of fuel containers being utilized to support the MCATF.

- An increase in the number of helicopter refueling stations and resupply pick-up points associated with the distribution of containerized fuel by helicopter.

3.7 Shipboard desired characteristics

Under the case 1 "seabasing" scenario, the 10 days of class III (diesel) and class IIIA (JP-5) currently held in the cantonment/BSA are to be stored instead in a combination of tanker and amphibious ships in the seabase. Desirable POL system characteristics, therefore, are similar to those of the cantonment/BSA. They include:

- An increase in material handling, marshalling, inventory control, and fuel dispensing capabilities related to processing large numbers of containers.

- Provision of adequate helicopter resupply pick-up stations within the seabase.

4. CURRENT AND PLANNED FUEL STORAGE AND DISTRIBUTION SYSTEMS

4.1 General. The Marine Corps currently has a family of systems and equipment for receiving, storing, and dispensing fuel to Marine air-ground task force units. These equipment include the amphibious assault fuel system (AAFS), the tactical airfield dispensing system (TAFDS), the helicopter expedient refueling system (HERS), M49A2C and M970 refueling trucks and semi-trailers, as well as 500 gallon collapsible fuel drums and five gallon gasoline cans. The 55-gallon steel drum is also still used to transport and issue fuel and lubricating oil in many situations. Other than evolutionary product improvement of these current systems the principal new Marine Corps equipment for fuel storage and dispensing are sixcon fuel storage and pump modules which are planned for introduction during the early 1980s as part of the field logistics system (FLS).

4.2 Amphibious assault fuel system.

The AAFS, as illustrated in figure B-7, is an aggregate of a number of self-contained units capable of receiving, transferring, and dispensing gasoline, diesel or jet fuels. As its name implies it was designed to be a flexible, rapidly installed system primarily for use during amphibious operations. The complete AAFS consists of the following component assemblies:

Component assembly	Quantity
Beach unloading station	1
Drum unloading units	2
Booster stations	2
Tank farms, 120,000-gallon capacity	5
Dispensing stations, each with six outlets	2

The beach unloading station consists of two tanks and two pumps, plus hose, valves, and manifolds. It provides the means for receiving fuel from various sources including tankers, LSTs, tank trucks, and shuttle craft, and from drums using drum unloading units. One of the unit's two pumps is used to unload fuel from delivering craft that have no integral pumping capability or from 55-gallon drums. The second pump is used to transfer fuel inland to the booster station.

Each booster station consists of one pump and two tanks. This is the main unit for transferring fuel inland. The fuel is received into the tanks from the unloading station and then pumped inland to the next booster station or to a tank farm. Each 600 gpm booster pump has a range of about 4,000 feet over level terrain with the total range of two booster stations and the beach unloading station being 2½ miles.

The tank farm is the basic storage unit. Each tank farm has six tanks which are filled from the last booster station, plus one pump to transfer fuel into, out of, or around the farm. From the tank farm, fuel is provided to the dispensing unit. This latter unit contains the manifolds, nozzles, meters, and hoses needed to dispense fuel.

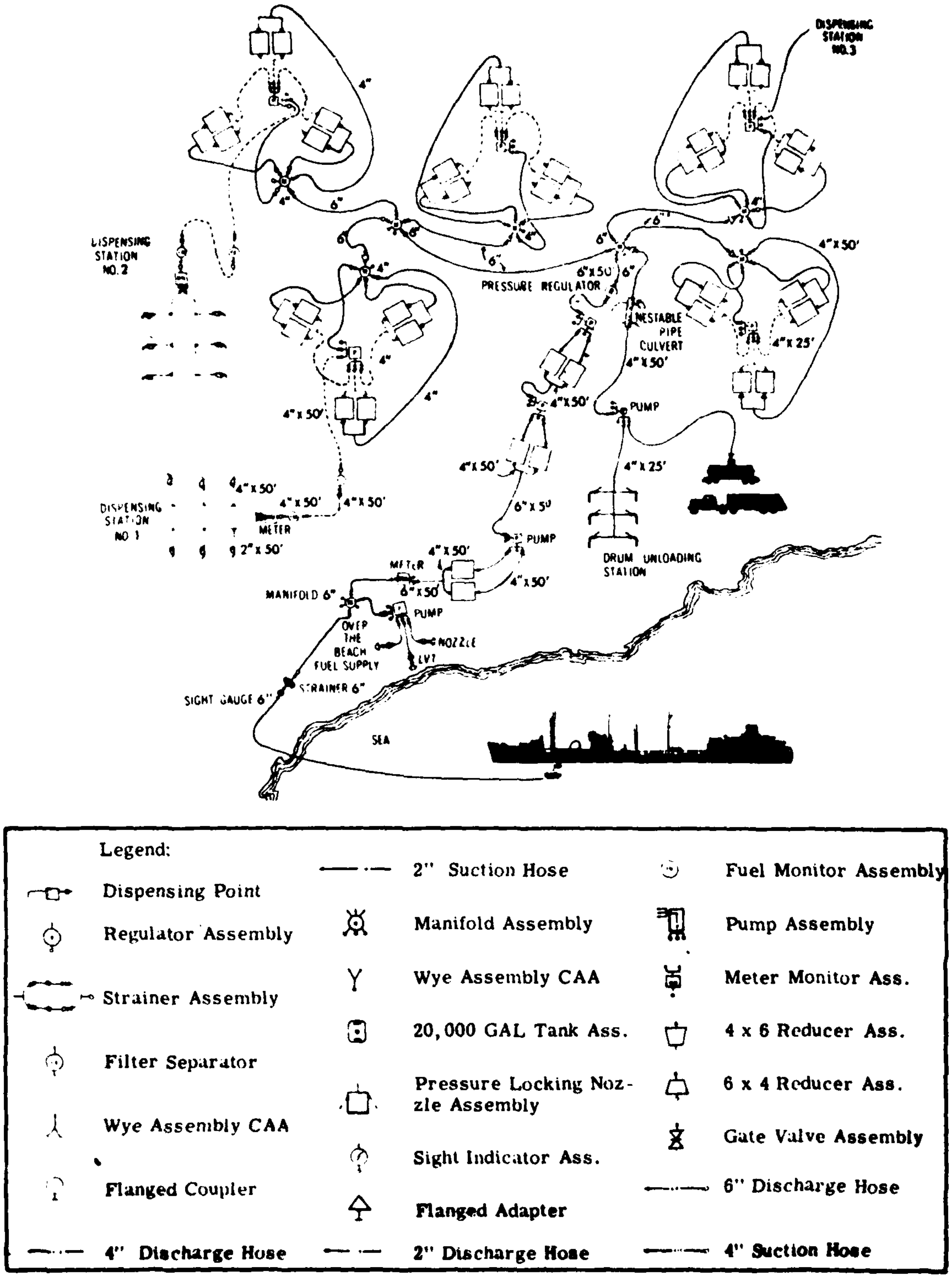

Figure B-7. Amphibious Assault Fuel System

The system is capable of receiving and transferring fuel to storage from naval craft through sea unloading lines at a rate of 600 GPM. Fuels may also be received and transferred from drums, LVTs or truck-borne tanks at rates up to 150 GPM. The system is further able to receive and transfer fuel from bulk tanks, both above and below ground, railroad tank cars, and commercial or military tank trucks at rates up to 200 GPM. It is capable of dispensing fuel to vehicles, individual containers, tank trucks, and aircraft at rates up to 350 GPM, depending upon the requirement.

The basic capacity for the AAFS is 600,000 gallons. It employs collapsible 20,000-gallon tanks and related components to provide five 120,000 gallon tank farms. Any other desired increase or decrease in storage capacity may be tailored to the system by the addition or deletion of tank farms or by the installation of additional complete systems. Each type component is standardized so that capabilities may be increased or decreased in building-block fashion using components from other units as needed. Two separate systems may be supplied from the same offshore source of supply; however, each system may contain only one type of fuel. A separate source of supply line must be provided for each type fuel.

The major equipment items of the current AAFS that are used to form the component assemblies described above are as follows:

Tanks. The system contains thirty-six 20,000 gallon collapsible fabric fuel tanks. The tanks are constructed of woven nylon fabric impregnated with petroleum resistant material. Thirty of the tanks are used in the fuel farms, with the other six being used in the booster and beach unloading stations. The tanks are about 30 feet by 25 feet by 4 feet when filled. Their empty weight is approximately 500 pounds each. The total weight and cube of the 36 tanks in their storage chests is about 30,000 pounds and 2,800 cubic feet respectively.

Pumps. The system includes ten trailer-mounted 600 gpm (at 125 psi) centrifugal pumps driven by multi-fuel diesel engines. These pumps weigh 3,200 pounds each. The total weight and cube for the ten units are 32,000 pounds and 1,400 cubic feet respectively.

Hose and couplings. Hoses provided are the 2-, 4-, and 6-inch diameter discharge type and 2- and 4-inch diameter suction type. The suction hose is wire reinforced to prevent collapse during use. The following quantities of hose are included in each AAFS:

6-inch discharge, 18,500 feet in 50-foot lengths
4-inch discharge, 7,500 feet in 50-foot lengths
2-inch discharge, 900 feet in 50 and 25-foot lengths
4-inch suction, 2,850 feet in 25-foot lengths
2-inch suction, 150 feet in 25-foot lengths

The total weight and cube for hose is 64,000 pounds and 6,000 cubic feet. Each length of hose comes complete with a male and female half of a cam-type quick connect fitting. These fittings are standardized throughout the system and are interconnectable, size for size. The heaviest hose item is a single 50-foot length of 6-inch discharge hose which weighs 112 pounds.

Filter-separators and fuel monitors. The system has four filter-separators and four fuel monitors, two pair for each dispensing unit. These units remove solid particles and undissolved water from the fuel before dispensing it. The fuel monitors are placed down stream from the filter-separators to block all flow if contaminants or water exceed a safe level. The total weight and cube of these eight items is 3,300 pounds and 520 cubic feet, respectively.

Other hardware. In addition to the major items listed above the AAFS has 66 four-inch valves and a collection of manifolds, adapters, reducers, nozzles, and other minor hardware items.

The total weight and cube of the AAFS is about 140,000 pounds and 11,400 cubic feet uncrated. The three major components--tanks, pumps, and hose--comprise 90 percent of this weight.

4.3 Tactical airfield fuel dispensing system. The TAFDS is a highly mobile, air transportable system designed to supply fuel to aircraft operating from expeditionary airfields. Basically, the system is similar to a tank farm of the AAFS but with the addition of extra pumps, filter-separators, and aircraft dispensing nozzles. The system contains six tanks, three pumps, and three filter-separators plus fuel monitors and related hardware. One system is capable of storing 120,000 gallons of fuel and simultaneously dispensing fuel through 18 gravity fueling nozzle outlets or 12 pressure fueling nozzle outlets. It is capable of a combined flow rate of up to 1,050 gpm. The TAFDS is usually installed as two separate tank farms of three 20,000 tanks each or as three tank farms of two tanks each. Each tank farm supplies fuel to the dispensing points through a pump, filter-separator, and fuel monitor. Any TAFDS system can be used as a whole, in part, or in conjunction with another system. Figure B-8 represents only one possible configuration. It can be supplied by truck, drums, pipeline (usually from the AAFS) or from the tanks of a KC-130 aircraft.

4.4 Helicopter expedient refueling system. The HERS is a relatively light, helicopter transportable system designed to refuel helicopters and other aircraft in forward areas. It can also be used to refuel ground vehicles. It consists of two 100 gpm pump assemblies, two filter-separators, eighteen 500 gallon collapsible fabric drums, four nozzles and associated hardware. Both D-1 type closed-circuit nozzles for pressure refueling of aircraft and open-port drop nozzles are provided. Recent allowance changes added a second pump and increased the number of drums from 12 to 18 to increase system flexibility. Also, it is planned that the current gasoline engine of the pump assembly will be replaced by a diesel engine.

4.5 Fuel storage containers.

500-gallon collapsible drum. This drum is a cylindrical non-vented container made of fabric impregnated with fuel-resistant, synthetic rubber. The drum has a closure plate at each end. The plates are tied together inside the drum with support cables so that they do not expand in length when the drum is filled. Each closure plate has a swivel ring with two anchor shackles to provide points where a lifting sling or towing and lifting yoke can be attached. Two models of the drum now in use are the long drum and the shortie drum.

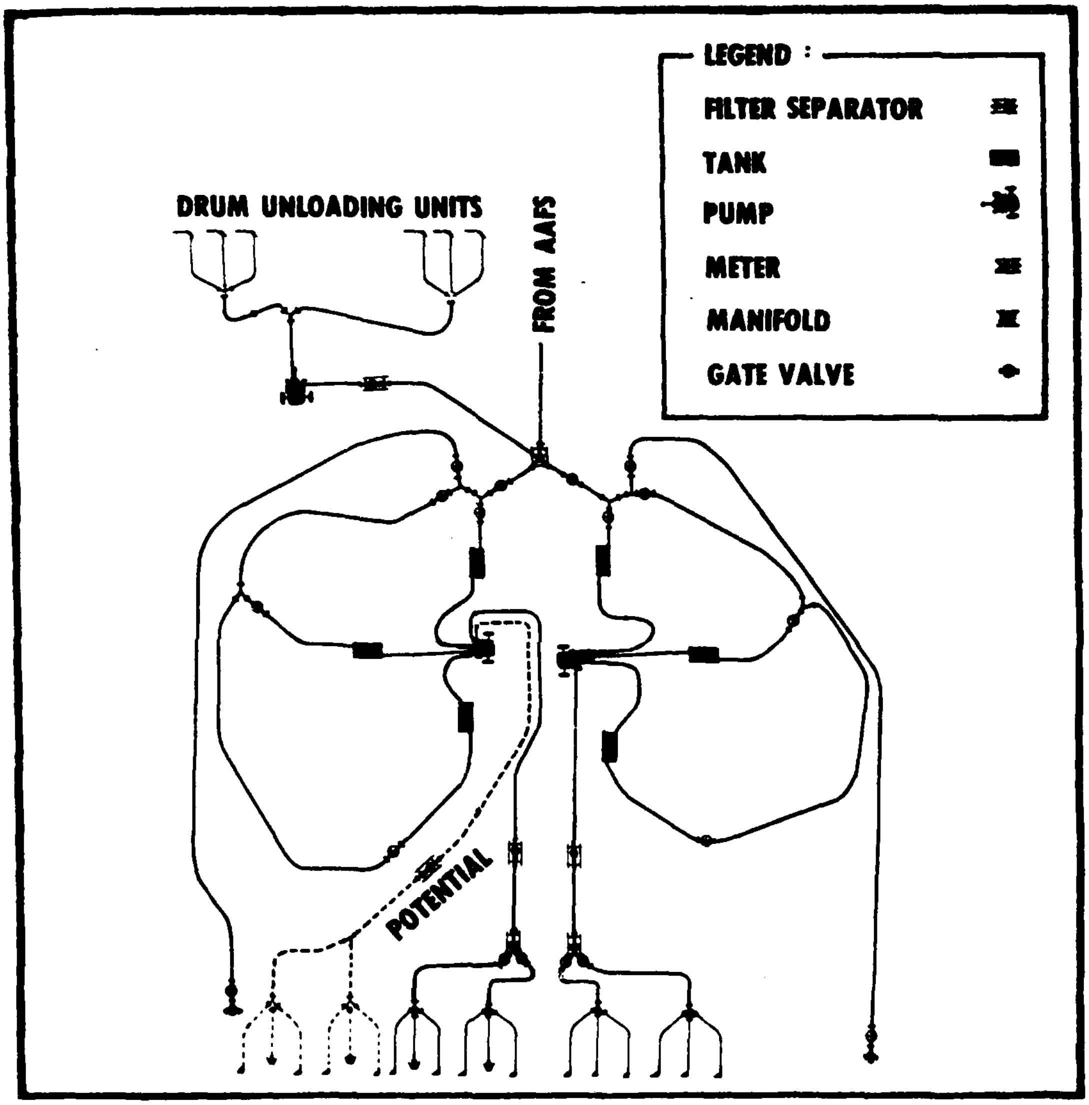

Figure B-8. Tactical Airfield Fuel Dispensing System

When filled the long drum is 6 feet 8 inches long and 3 feet 10 inches in diameter--the shortie drum is 5 feet 2 inches long and 4 feet 5 inches in diameter. The drum can be used for storage or transporting fuel. Filled drums can be rolled by hand, towed short distances by vehicles using a towing and lifting yoke, used with a tiedown kit to convert cargo trucks into fuel carriers, transported by helicopters or fixed wing transport aircraft, and transported by LVTs.

55-gallon steel drum. Prior to the development of bulk fuel storage systems this drum was the primary means for moving fuel in assault operations. However, the drums are still used to issue fuel and lubricating oil to using units in some situations.

5-gallon gasoline can. This can is used primarily to store and issue small quantities of fuel to using units. Most combat vehicles have mounts for carrying these cans as a reserve fuel supply. It is especially useful when conditions are such that a fuel container must be carried by hand. The 5-gallon can is also the primary means for storage and dispensing of lubricating (lube) oil at the using unit level.

4.6 Refueling vehicles. The Marine Corps currently has two primary vehicles for transporting and dispensing fuel--the M49A2C tank truck and the M970 semi-trailer refueler. The M49A2C has a 1,200 gallon stainless steel tank body shell divided into two 600-gallon compartments. The truck is used mainly for transporting bulk fuel and general refueling. The truck can carry fuel both on and off the road. However, it can carry only 600 gallons when it travels off the road because the forward tank must be left empty. The truck can be used to fill drums and cans and to refuel ground vehicles. It can also be used in the open-port refueling of aircraft. The M970 tank body also is made of stainless steel and it is divided into two 2,500-gallon compartments. The semi-trailer is similarly used to transport fuel, transfer fuel to containers, and refuel ground vehicles and aircraft. When traveling cross-country it must operate at a reduced payload of 3,500 gallons (1,650 gallons in each tank compartment).

4.7 Sixcon fuel and pump modules.

The Marine Corps is currently developing a new field logistics system (FLS) whose major components are the Marine Corps expeditionary shelter system (MCESS), a standard family of cargo containers, and a new vehicle fleet. Under the FLS concept many service support items of equipment have been dismounted from dedicated trailers and vehicles. The purpose of this approach is to reduce overall equipment maintenance requirements and costs, improve trailer and prime mover availability, and enhance employment flexibility for their respective functional roles. Further, the service support items have been modified and configured in modular form to permit their enclosure in dimensionally standardized ANSI/ISO containers, shelters, and shipping frames. These service support modules interface with and are dependent on the other FLS subsystems, i.e., container, shelter, motor transport, and material handling equipment. The concept for their employment is dependent upon an intermodal transport capability within the amphibious objective area. This may employ either air or ground transportation for delivery of the modules to intended users.

The two service support modules of interest in the FLS being developed are the fuel storage module and the pump module. The original fuel storage module prototype was constructed with a collapsible rubber tank with an intended capacity of 1,200 gallons. The tank has since been converted to a rigid metal tank in order to eliminate leakage problems and improve the limited shelf life associated with a fabric tank. The current fuel storage module has a stainless 900-gallon tank with associated hardware mounted in a 4' x 6-2/3' x 8' metal shipping frame. The frames have ANSI/ISO fittings to enable use of connectors which permit six frames, when arrayed in a 2 x 3 configuration, to be locked together to form a sixcon that is compatible with the international dimensional standards of an 8' x 8' x 20' container. It has an empty weight of approximately 2,500 pounds.

The pump module consists of a pump driven by a diesel engine, a filtration system, transfer system, and dispensing hardware, all mounted in a basic shipping frame which has ANSI/ISO fittings. The pump is used with the fuel storage module where a pumping capability is required. It weighs approximately 3,000 pounds and has a liquid transfer rate of 100 gpm. Hoses and fittings are provided so that a number of modules (maximum of five) can be simultaneously connected to the pump section for rapid discharge. Five fuel storage modules and one pump module can be joined together to form a standard 8' x 8' x 20' configuration. As noted above the current pump is diesel driven, however, investigations are underway to ascertain the feasibility of a lower capability (50 gpm) pump powered by a vehicle's 12-volt electrical system.

A related accessory module has also been developed by the Marine Corps. It consists of an empty module with a nylon restraining system that will be used for the storage and movement of nozzles, nozzle stands, and miscellaneous hoses and spare parts for special-purpose fueling operations, such as helicopters and V/STOL attack aircraft which will normally require TAFDS dispensing equipment for servicing.

Heavy-duty portable jackstands have also been developed to elevate the modules up to 60 inches off the ground. This will allow a gravity feed to fuel receiving equipment and containers at relatively fixed locations for units having limited fuel requirements. These jackstands will also permit loading and unloading of modules from vehicles without the need for forklift support.

5. EVALUATION OF CURRENT AND PLANNED SYSTEMS

5.1 General.

This section presents an evaluation of the current and planned fuel storage and distribution systems as they could be used in various MCATF support concepts. As identified in the introduction to the annex, four support combination cases were isolated for evaluation. The elements of each case are again listed in table B-18. Each of these cases is discussed separately in subsequent paragraphs.

In concert with the long-range concepts discussed in the basic report and section 1, a fundamental influence common to all cases is that the land area between the MCATF and its resupply facility would normally not be controlled by friendly forces. Thus, airlift is used as the primary means of transporting supplies to the MCATF. Also for purposes of this study a 75 NM radius of operations has been established as the notional distance between the MCATF and its resupply source.

Table B-18. Maneuver Element/Support Cases

	Case 1	Case 2	Case 3	Case 4
Maneuver element (includes unit train)	MCATF-4ME	MCATF-4ME	TF-ALPHA	LAAB
Self-sufficient				X
CSSA Support		X		
MCSSD Support			X	
Cantonment Support		X	X	
Shipboard support	X			

5.2 Case 1.

5.2.1 General.

This case requires that a four maneuver element MCATF be supported directly from a sea base with no intermediate support facility ashore. In brief, these support conditions will require that 49,580 gallons of diesel fuel and 10,800 gallons of JP-5 be available on ships that can land helicopters, be airlifted by helicopter to the MCATF, and then be stored and subsequently dispensed to 555 vehicles and 24 attack helicopters on a daily basis. The capability of current and planned fuel storage and distribution equipment as it is relative to the three major parts of the system--the MCATF, the airlift, and shipboard facilities--are discussed in the following paragraphs.

5.2.2 MCATF storage and distribution systems.

The basic fuel storage and distribution system organic to mobile mechanized forces is currently provided by M49A2C tank trucks which rendezvous with using vehicles on demand. These organic refueling vehicles normally obtain their fuel resupply from bulk fuel systems if distance to the AAFS or TAFDS is not prohibitive, or from M970 tank semi-trailers that shuttle between the bulk systems and unit refuelers. Expedient refueling systems also may be installed along convoy routes or in forward areas to augment organic refueling capabilities. However, as noted in the post-exercise evaluation of the MCATF-Phase

IV operation during tests at 29 Palms, California in 1981, the relative immobility of current CSS elements seriously constrains MCATF flexibility. Loaded trucks such as the M49A2C were found ill suited to off-road travel and were slow when traveling unimproved roads. Thus, even though the maneuver elements could easily change their direction of advance, frequently CSS elements could not follow to satisfactorily support tactical operations. This creates a mismatch between MCATF maneuver and CSS units.

It is currently planned under the new FLS concept that these refuelers will be replaced by sixcon fuel and pump modules carried on cargo trucks. As discussed in the volume I report it is envisioned that during the long-range time period these modules would be transported on 22½-ton, 8x8, dragon wagons, articulated tractor-trailer units with high mobility and survivability characteristics. It is planned that each dragon wagon would be loaded with several fuel storage modules plus a pump module containing a pump, filter, and hose unit for dispensing fuel. The dragon wagon will have a hydraulic crane mounted on the vehicle, which can be used for loading and off-loading modules.

Using a "filling station" concept, these dragon wagons configured as fuel transport/storage vehicles would move on demand from the unit train area to a selected rendezvous location, dispense fuel directly to the MCATF vehicles, and then return to the trains area. Due to its high mobility characteristics the use of dragon wagons in this role would provide a means for moving fuel to the mobile combat units essentially unconstrained by terrain. This would appear to solve the maneuver element/CSS train mobility mismatch identified in the MCATF-Phase IV operational tests.

The capability of the planned sixcon fuel pump module to discharge fuel through one nozzle at 100 GPM or two nozzles at 50 GPM is considered compatible for intended refueling operations with maneuver unit vehicles. The timing, frequency, and volume of fuel to be delivered to combat vehicles in each maneuver unit would in actual practice be situation dependent. Normally refueling/resupply operations would be planned during the night, but could occur throughout the day as individual unit demands varied. The high mobility of dragon wagon vehicles together with their ability to carry mixed loads of supplies to match individual unit demands would enhance CSS flexibility and responsiveness in the normal combat environment of fluctuating requirements.

The major apparent disadvantage of the planned sixcon/dragon wagon refueling vehicle is the need to allocate some payload weight and space available on each vehicle to a pump module. This detracts from the amount of fuel that can be carried by each refueling vehicle. This apparent deficiency would appear correctable by a fuel pump that could be mounted under the trailer chassis and powered from the vehicle's electrical system. Such a pump system is currently under evaluation by the Marine Corps.

The dragon wagon with sixcon fuel and pump modules would also be used to dispense JP-5 fuel directly to the supporting attack helicopters at selected rendezvous/refueling areas. The same type of fuel and pump modules as used with the MCATF combat vehicles would be utilized.

While the dragon wagon/sixcon refueler is considered to be the most efficient fuel storage and distribution system for highly mobile MCATF units and supporting helicopters using current and planned equipment, it should be recognized that expedient refueling systems such as HERS would have the potential for augmenting the primary system in selected situations. When the tactical environment requires or permits it, this type of system could be used at semi-mobile sites for refueling vehicles or helicopters within the MCATF controlled area or as preplanned rendezvous "caches" in fluid battlefield conditions requiring fuel resupply beyond the immediate secure range of a MCATF's CSS train.

5.2.3 Helicopter lift resupply.

The nature of the case 1 tactical concept requires that all fuel be transported from ships directly to the maneuver element unit trains by helicopter. The primary transport helicopter available for this type lift during the long-range time period is programmed to be the CH-53E. The primary current and planned fuel containers available for packaging fuel for helicopter lift are the sixcon fuel modules and 500-gallon collapsible drums.

Based on the performance capabilities as set forth in the Center for Naval Analyses memorandum 79-3113 of 2 November 1979, the CH-53E would provide a payload capability of approximately 13 tons with internal loads and 12.3 tons with external loads at a 75 NM radius of operations when the initial takeoff conditions are computed for sea level/90°F elevation and temperature conditions. Using an average combat utilization rate of 90 hours per month for each aircraft, the number of CH-53Es required to sustain the delivery of various volumes of fuel at these mission profile conditions is presented in figure B-9. From this figure it can be observed that the number of CH-53Es required to satisfy the MCATF-4ME daily fuel demands of 60,380 gallons (49,580 Class III plus 10,800 Class IIIA) would be approximately 13 CH-53Es when cargo is carried internally or 15 CH-53Es using external lift. Only the 500-gallon collapsible drum is used to package fuel for internal lift in the illustration because the sixcon fuel module exceeds the internal cargo compartment dimensions of the CH-53E. Three sixcon fuel modules are utilized as the fuel packaging means for external lift transport.

The comparative helicopter requirements data shown in figure B-9 indicate that it would be approximately 15 percent more efficient to transport fuel internally in the CH-53E with 500-gallon collapsible drums. This greater efficiency is obtained for two reasons. First, internal loading of helicopters eliminates the added flat plate drag associated with external loads, thus allowing higher cruise speed and reduced mission flight time. Second, the 500-gallon collapsible drum is a significantly lighter container than the sixcon fuel module. The 285 pound empty weight of the drum is only 8.14 percent of its 3,500 pound payload weight with 500 gallons of diesel fuel. Whereas, the 2,500 pound empty weight of a sixcon fuel storage module is approximately 39.68 percent of its 6,300 pound payload when loaded with 900 gallons of diesel fuel.

The apparent advantage of the 500-gallon collapsible drum as a container for internal fuel transport by helicopter, however, has significant off-setting

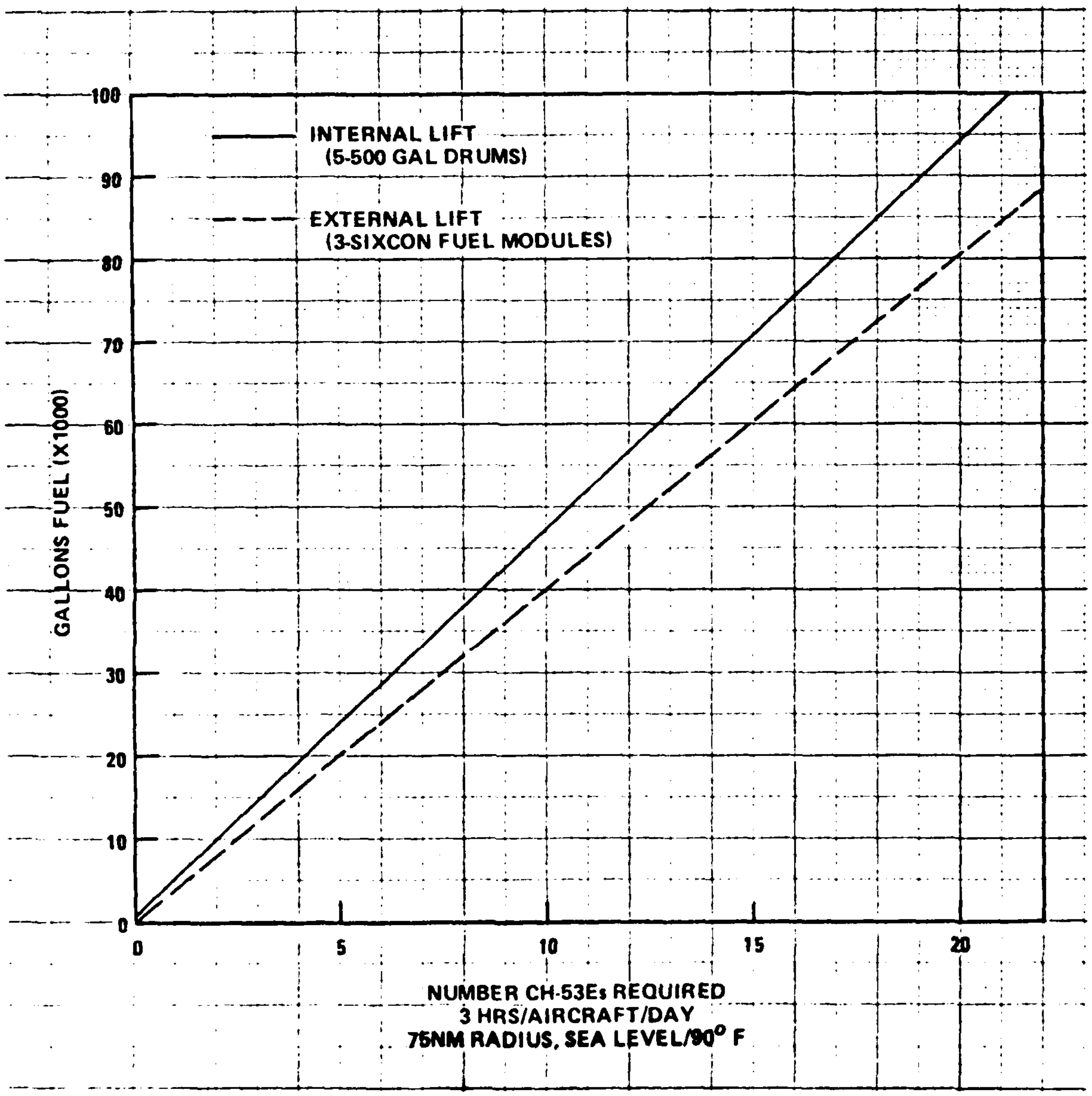

Figure B-9. <u>CH-53E Daily Fuel Delivery Capability</u>

disadvantages. The basic disadvantage is aircraft safety. Experienced Marine Corps helicopter pilots and loading test officers are nearly unanimous in their judgment that bulk fuel should be carried externally. The potential for fuel container leakage resulting from enemy action or other causes, plus the need to have a capability to rapidly jettison cargo during aircraft emergencies at high gross weights, are factors counseling against the internal carrying of fuel containers. Another potential disadvantage of using the 500-gallon collapsible drum as a standard aerial transport fuel container is its interface with MCATF units supported by sixcon configured refuelers. Fuel transported by sixcon modules could be readily loaded and off-loaded from the dragon wagon trailers by organic vehicular cranes. In contrast, delivery by drums would require the extra handling step of pumping fuel from the drums to the refueler modules. If, on the other hand, an all 500-gallon collapsible drum fuel distribution system were adopted (i.e., also replace the sixcon fuel module used in ground units with 500-gallon collapsible drums), then all of the modular advantages of interconnection, ease in handling, reduced hose requirements, and the ANSI/ISO commonality with commercial container configured transportation would be lost. Clearly the daily support savings of two CH-53E helicopters does not offset the advantages of retaining the sixcon concept. Regardless of the delivery means, however, empty containers must be temporarily stored by the MCATF CSS trains and subsequently returned by helicopter lift to the resupply source.

5.2.4 Shipboard facilities.

Under the support conditions of this case the MCATF-4ME will be dependent on ships as a source of fuel resupply. This will require that the ships of the amphibious task force/group (ATF/G) transporting and supporting the MCATF provide adequate storage, dispensing, and container staging facilities for the required fuel as well as operating support facilities for transport helicopters.

A listing of the representative types of ships that would be in an ATF/G, together with typical capacities for landing force fuel is presented in table B-19. The LPH- and LHA-type ships by design would be the primary operating bases for helicopters. Each of the other types of amphibious ships are air capable in that they have landing platforms suitable for helicopters as large as the CH-53E and provide limited aircraft service support. As can be noted from table B-19, the amount of fuel varies substantially between ship types. These capacities also vary between ships within a class because of design changes during construction and phased alterations installed during overhauls. There is a general trend toward phasing out aviation and motor gasoline storage and increasing diesel and JP-5 storage capacities in concert with changes in landing force equipment usage. However, the current fuel storage provisions on amphibious ships basically reflect the operational support concept envisioned during design.

Table B-19. Representative Amphibious Ship Fuel Capacities[1/]

Ship/Class	MOGAS	Diesel	JP-5	Av. Gas
		Gallons of Fuel		
LHA-1	10,000		400,000	
LPH-2	6,525		266,033	23,523
LPD-1	20,000		224,000	97,440
LPD-4	21,958		350,625	97,328
LSD-28	21,250	39,000		
LSD-36	2,000	30,882	32,526	
LST-1179	7,197	254,000		132,481

Note 1: Data source-ECP 3-4 Amphibious Ships, Landing Craft, and Vehicles, Education Center, MCDEC, Quantico, Va. 16 May 1980.

The thrust of operational concepts during design of current amphibious ships was toward support of initial assaults executed primarily by helicopter-borne forces with complementary surface landings for heavier forces. An infantry-heavy type landing force structure also dominated related ships characteristics. Thus, the most air capable ships--LPH, LHA, and LPD--were designed with fuel provisions to support extensive helicopter operations in support of infantry forces. Fuel for ground vehicles was generally sized to the relatively limited number of embarked vehicles and their resupply requirements during the assault phase. The large fuel capacity of the LST reflects its ability to beach and a need within the ATF/G to provide an initial source for the amphibious assault fuel system to support subsequent operations ashore.

It is recognized that the number and mix of ship types within an ATF/G will vary because of ship availability and total landing force lift requirements; however, collectively, there are extensive fuel resupply resources within these ship types even though their original design preceeded the higher fuel consuming MCATF-type operational concepts discussed herein. As identified in paragraph 2.6 a MCATF-4ME would require shipboard storage/resupply capability for approximately 500,000 gallons of diesel fuel and 100,000 gallons of JP-5 based on a 10-day level of supply. This level of support should be available in most ATF/G ship mixes in addition to the fuel demands for seabased transport helicopter, V/STOL attack aircraft, and other non-MCATF specific requirements. However, it will be noted from table B-19 that the fuel of highest demand--diesel--is located on the least air capable LSD and LST-type ships. Due to the restricted number of helicopters that can be accommodated on these ships during high-tempo operations, the responsiveness of delivering such fuel to the MCATF may be seriously constrained. Conversion of gasoline stowage spaces to diesel stowage on the more helicopter capable ships, such as the LPHs, could be one method toward achieving a better ship/helicopter lift type fuel demand balance within the ATF/G. Another potential approach would be to preplan selective allocation of some JP-5 stowage/distribution capabilities on

LHAs, LPHs, or LPDs to diesel fuel when MCATF-type operations are to be resupplied by helicopter lift.

Another significant consideration when extensive helicopterborne fuel resupply operations are conducted from amphibious ships will be space and facility allocation for staging fuel containers. To support the daily demand for a MCATF-4ME approximately 67 sixcon-type fuel modules must be prepositioned, filled, and staged for helicopter lift. Space for the additional returning empty and reserve fuel modules also must be provided. This will require detailed preplanning to control the movement of large numbers of containers, and to match fuel availability and module stowage and handling capabilities with helicopter pick-up spots on the ships allocated for the fuel resupply task.

5.3 Case 2.

5.3.1 General.

The conditions established for this case require that a four maneuver element MCATF be supported from a CSSA that is established in a forward area ashore to improve the responsiveness of combat service support from a cantonment/BSA. The MCATF support requirements in this case of 49,500 gallons of diesel fuel and 10,800 gallons of JP-5 are the same as for Case 1. Thus, the MCATF internal storage and distribution system would be the same as discussed for Case 1. Similarly, the helicopter lift discussion presented for Case 1 would be equally applicable to this case since the CSSA and the cantonment/BSA are basically land-based support facilities that substitute for seabased sources of resupply. The 75 NM radius of operation remains a constant criterion for MCATF support in all cases. Accordingly, subsequent discussion for this case focuses on highlighting fuel storage and distribution features at the CSSA and cantonment/BSA.

5.3.2 CSSA facilities.

The representative CSSA developed for this study provides a facility between the cantonment/BSA and the maneuvering MCATF to improve the responsiveness of combat service support. Its notional sizing and configuration for this report is based on maintaining a five day base of supply for a supported MCATF with four maneuver elements; providing an expeditionary V/STOL facility capable of supporting six AV-8-type aircraft; and providing resources needed for the internal operation of the CSSA. A detailed configuration of the CSSA is presented in the basic report.

As developed in paragraph 2.3 the total 5-day fuel storage requirement for the CSSA is 281,285 gallons of diesel fuel and 124,000 gallons of JP-5. Approximately 12 percent of the diesel fuel requirement is for the needs of CSSA based-equipment; 56 percent of the JP-5 fuel storage is for the V/STOL facility located at the CSSA. The remainder of the requirement of 247,900 gallons of diesel fuel and 54,000 gallons of JP-5 fuel represents a five day level of supply for the supported MCATF.

This relatively large storage and distribution demand will require the use of bulk fuel storage as well as a multi-point distribution system. Accordingly, the use of several TAFDS systems is considered the most efficient method of satisfying this requirement with current or planned equipment. Using the inherent flexibility of the TAFDS system, separate tank farms could be established readily in accordance with current procedures for the V/STOL facility and both internal and MCATF support demands for the two-type fuels. Employment of TAFDS systems at the CSSA also would provide for a ready link with cantonment/BSA facilities for sustained fuel resupply by whatever means.

As in any support of a MCATF by transport helicopters from a rear supply source, the CSSA must include provisions for storage, filling, and staging helicopter-lifted fuel containers. For support of a MCATF-4ME this will require that on an average day 67 sixcon fuel modules be staged at helicopter pickup points, filled, and rigged with slings for lift. Provisions for receiving, staging, and returning the empty containers also must be made. Separate TAFDS systems for storage and filling these modules with two fuel types adjacent to several helicopter landing points are provided in this study's representative CSSA facility in volume I.

5.3.3 Cantonment/BSA facilities.

The fuel resupply for the condition of this case would flow from a cantonment/BSA to a CSSA and finally by helicopter lift to the supported MCATF. As discussed in paragraph 2.5 the most rearward cantonment/BSA facility normally would be sized to support the entire MAGTF less requirements for MAW elements operating at remote theater airfields. While it is beyond the scope of this study to determine the complete quantitative fuel requirements for a MAF-type MAGTF, the requirements as they relate to MCATF demands (of primay concern herein) basically outline qualitative fuel storage and distribution needs for a larger force within the cantonment/BSA. Based on previously computed data, the cantonment area fuel storage requirement for support of a MCATF-4ME with a forward CSSA would be 562,570 gallons of diesel fuel and 248,000 gallons of JP-5 at a ten day level of supply storage criterion. This level of demand will require bulk fuel systems for efficient storage and distribution. Such requirements can be adequately satisfied by the current AAFS-type system with one standard AAFS devoted to the storage and distribution of diesel fuel and portions of a second AAFS used for JP-5 fuel.

The AAFS-type system would also provide booster station component assemblies for link-up to any host country or U.S. Army provided pipeline that may be available for servicing an inland CSSA. In the event such a pipeline is not available, however, daily fuel resupply of the CSSA can best be provided by a fleet of M970 semi-trailer tankers (or alternatively, less cost-effective sixcon configured dragon wagons). For example, after the initial build-up of the 5-day supply in the CSSA, 23 M970s (using a 1.3 multiple to compensate for downtime and turnaround) could maintain the case 2 daily resupply rate of 56,230 gallons of diesel and 24,800 gallons of JP-5.

Consideration of the need for Marine Corps development of a pipeline capability is contingent upon the likelihood of the Marine Corps fielding MCATFs larger than in case 2, in situations wherein neither the U.S. Army or host country fuel support is available (i.e., non-RDJTF). For example, a

non-RDJTF commitment of the case 3 (three regimental) MCATF, utilizing a single MCATF-supporting CSSA with a V/STOL facility, would require Marine Corps daily resupply to the CSSA of 114,900 gallons of diesel and 46,400 gallons of JP-5, making Marine Corps pipeline resupply very advantageous. In the near term (i.e., the next 10 years) the probability of such a situation is considered low; however, the likelihood will increase with the attainment of the equipment of the three maritime prepositioned ship (MPS) brigades. Therefore, the status of the MPS program, and the associated probability of a large MCATF-type deployment supported only by the traditional Navy-Marine Corps amphibious team, should be assessed yearly from the point of view of the desirability of developing a Marine Corps pipeline capability.

A MCATF supporting cantonment/BSA must also be prepared for the high-volume usage of helicopter-transportable fuel containers. This will require not only maintaining a significant reserve module stock, but providing for their related inventory control, staging, and material handling.

Using current capabilities the demand for tanker truck/pipeline transfer of JP-5 fuel could be substantially mitigated if a KC-130 suitable airfield is available at the CSSA. Under such conditions the capability of the KC-130 to transport and offload fuel to a TAFDS could be used to resupply a CSSA by airlift. In its inflight refueling configuration a KC-130 operating from a theater airfield 250 NM from the CSSA could typically offload approximately 5,100 gallons per sortie when operating at 120,000 pounds initial takeoff gross weight, or 7,300 gallons per sortie at 140,000 pounds initial takeoff gross weight. At these potential capabilities, 4 or 5 KC-130 sorties could satisfy the average daily requirement for JP-5 at the representative CSSA.

5.4 Case 3.

5.4.1 General.

This case requires that a regimental size MCATF be supported from a cantonment/BSA and a MCSSD collocated with another MCATF operating closer to the cantonment/BSA. It is similar to Case 2 except for the detailed configuration of the MCATF and the use of a MCSSD as the forward support link from the cantonment/BSA in lieu of a CSSA. Since cantonment/BSA equipment characteristics and maneuver element qualitative systems for this case parallel those of Case 2 discussions, subsequent discussion isolates on variations related to airlift resupply and the MCSSD requirements.

5.4.2 Helicopter lift resupply.

The MCATF used for sizing this case is a representative slice from a three regimental MCATF force that could be formed from the tank, AAV, and self-propelled artillery resources of one Marine division and up to three MPS brigades. Designated as Task Force ALPHA (TF-ALPHA) in this study, it includes two balanced tank-infantry MEs and one infantry-heavy ME.

Based on the data presented in table B-8 the daily fuel resupply requirement for this force is 37,981 gallons of diesel and 10,800 gallons of JP-5. This daily requirement level is approximately 19 percent less than that

established for a four element MCATF used for Case 1 and 2 analyses. This lesser requirement for resupply is reflected in a corresponding fewer number of transport helicopters needed to satisfy airlift demands. As shown in figure B-9 approximately 13 CH-53Es would be required to satisfy the TF-ALPHA level of daily resupply using external lift techniques in contrast with the 15 aircraft needed for MCATF-4ME support. Case 1 discussions of airlift techniques and transported fuel containers tradeoffs relative to the advantages of external lift of sixcon fuel modules are equally germane to this TF-ALPHA support analysis.

5.4.3 MCSSD support.

The MCSSD is a mobile combat service support detachment organized to carry one day of support for a MCATF. Under the employment concepts presented in this report it would operate to the rear of a supported MCATF in company with another MCATF whose combat forces would provide security for the MCSSD.

The structure of the MCSSD and its resultant fuel storage requirement is based on the vehicles required to carry one day of supplies for a Task Force ALPHA-type MCATF plus those necessary for its internal operation. This will require that the MCSSD be capable of carrying 37,981 gallons of diesel fuel and 10,800 gallons of JP-5 for TF-ALPHA and 4,310 gallons of diesel fuel for internal MCSSD consumption.

While the emphasis for the MCSSD will be on the wholesale receipt, storage, and transfer of fuel on demand to a forward MCATF rather than extensive level retail distribution, its fuel system must be compatible with elements of the total throughput system. Also, since this detachment must operate in company with another MCATF for security it is essential that it possess equal cross-country mobility. Thus, like elements of a MCATF's unit train, as discussed in Case 1, the most effective means for carrying MCSSD fuel stocks using current and planned equipment would be the utilization of dragon wagon mounted sixcon fuel modules.

5.5 Case 4.

The final case reviewed in this evaluation is a light armored assault battalion (LAAB) equipped to be self-sufficient for a short term independent mission with no resupply during the mission. This force is significantly different from other cases in both the size of the MCATF and its employment concept.

Based on the currently proposed LAAB structure, as shown in table B-9 previously, this force would have 145 light armored vehicles including 16 LAV(L) logistics carrier variants. While the original rationale for the number of logistics variants could not be established, it was estimated in the main body of the report (volume I) that 4 of the LAV(L)s would be utilized for transport of Class III reserve stocks. The daily fuel consumption for all LAAB vehicles would be 8,700 gallons of diesel fuel as established in paragraph 2.2.3.

Under the conditions of its employment concepts in this case, fuel for the LAAB would be limited to that carried in each vehicle's tanks plus the limited reserve stock storage in selected LAV(L)s. Although the configuration of the

LAV(L) variant has not been detailed, internal cargo space on similar vehicles would indicate that at least the equivalent of one 500-gallon collapsible drum could be carried by each LAV(L). This capacity would provide a LAAB as now structured with a fuel reserve of approximately 22 percent of daily battalion usage assuming four LAV(L)s are utilized for fuel transport. Whether or not this amount of fuel reserve is adequate would be dependent on the contingencies of each specific combat situation. However, regardless of the amount of fuel reserve for any specific mission the type of fuel supply vehicle should be a LAV-type variant. Mobility capabilities of a LAV are essential to insure that logistics vehicles can maintain station with LAAB combat vehicles during cross-country movement. Also due to the probability of tactical insertion and extraction of the battalion by helicopter, no augmentation of the unit train with non-helicopter transportable vehicles is possible.

In the light of the potential constraint imposed on LAAB operations during independent missions without fuel resupply it is considered prudent that LAV vehicles be configured for intervehicle fuel transfer. In most operations some vehicles and/or units of the LAAB will be employed on higher fuel consuming profiles than others. Also in some cases disabled vehicles could provide a secondary reserve fuel source. Thus to help extend time-on-station in balance with other battalion elements, ideally each vehicle should have a capability to readily transfer fuel. An electrical driven fuel pump with a capacity in the range of 15-25 gpm plus a light weight hose and nozzle assembly could satisfy this requirement. If this capability is not provided on each vehicle, at a minimum each seperate task force element should have several portable pumps systems within its units to accomplish interforce fuel transfer.

5.6 <u>Summary of current and planned fuel system capabilities</u>.

The following major conclusions are drawn from the above case evaluations of MCATF combat service support operations with current and planned fuel system capabilities.

- <u>MCATF/MCSSD storage and distribution systems</u>.

  - Sixcon fuel modules mounted on dragon wagon vehicles would be the most effective storage and distribution system for MCATF-4ME and TF-ALPHA-type MCATFs, as well as supporting MCSSDs.

  - Electrical driven fuel pumps on each dragon wagon refueler would eliminate the need for a sixcon pump module on each vehicle thus providing additional space for carrying fuel storage modules.

  - An intervehicle fuel transfer capability is considered essential for LAAB-type units on independent mission without planned fuel resupply.

- <u>Helicopter lift systems and techniques</u>.

  - Internal cabin carrying of fuel in 500-gallon collapsible drums would be the most efficient method of fuel transport by

helicopter to MCATF units. However, safety and the need for total fuel resupply system compatibility require the use of external lift and the less efficient sixcon fuel modules.

- •• The current sixcon fuel module has a very high empty (TARE) weight relative to its payload capacity.

- Shipboard facilities.

  - •• Current amphibious ships of an ATF/G have a significant fuel storage capability. However, the availability of diesel fuel designated for troop use is limited on ships with the greatest capability for supporting sustained helicopter operations.

  - •• Fuel resupply of MCATF units from ships will require detailed planning for the most efficient staging and control of fuel modules.

- CSSA/cantonment facilities.

  - •• The current AAFS and TAFDS-type fuel storage and distribution systems adequately satisfy MCATF-related needs at a CSSA or cantonment/BSA support facility.

  - •• A fleet of M970 semi-trailer refuelers (or alternatively, sixcon configured dragon wagons) would normally be the preferred means for providing the fuel resupply link between the cantonment/BSA and the CSSA.

  - •• The task of staging and inventory control of sixcon fuel modules will require specific emphasis when MCATF units are supported by helicopter lift.

6. OTHER FUEL STORAGE AND DISTRIBUTION SYSTEMS

6.1 US Army systems.

The US Army has been the principal developer and user of fuel storage and distribution systems for moving large quantities of fuel in support of military operations. An outline of a representative US Army bulk petroleum distribution system in a combat theater is shown in figure B-10. As illustrated, the basic input would be from tankers moored by off-shore or dockside mooring systems. Fuel is moved through a submarine or floating hoseline and offloaded into either a tactical Marine terminal or fixed facilities consisting of bolted steel tanks. It is then moved through a split-ring grooved-type coupling pipeline, tactical pipeline, or hoseline for use by airfields, or for storage in large 50,000 gallon collapsible fabric tanks of the petroleum supply companies. (Also note the use of hoseline to move fuel from rail cars to a fuel system supply point (FSSP).) On the basis of requirements the petroleum supply battalion issues fuel to direct support supply and service (S&S) companies operating in corps and division areas. Fuel will be moved to these companies by means of 5,000 gallon tank trucks from the medium POL truck companies. In turn, fuel will be moved from the FSSPs of the S&S companies to the brigade trains area by means of tank trucks of the transportation company of the

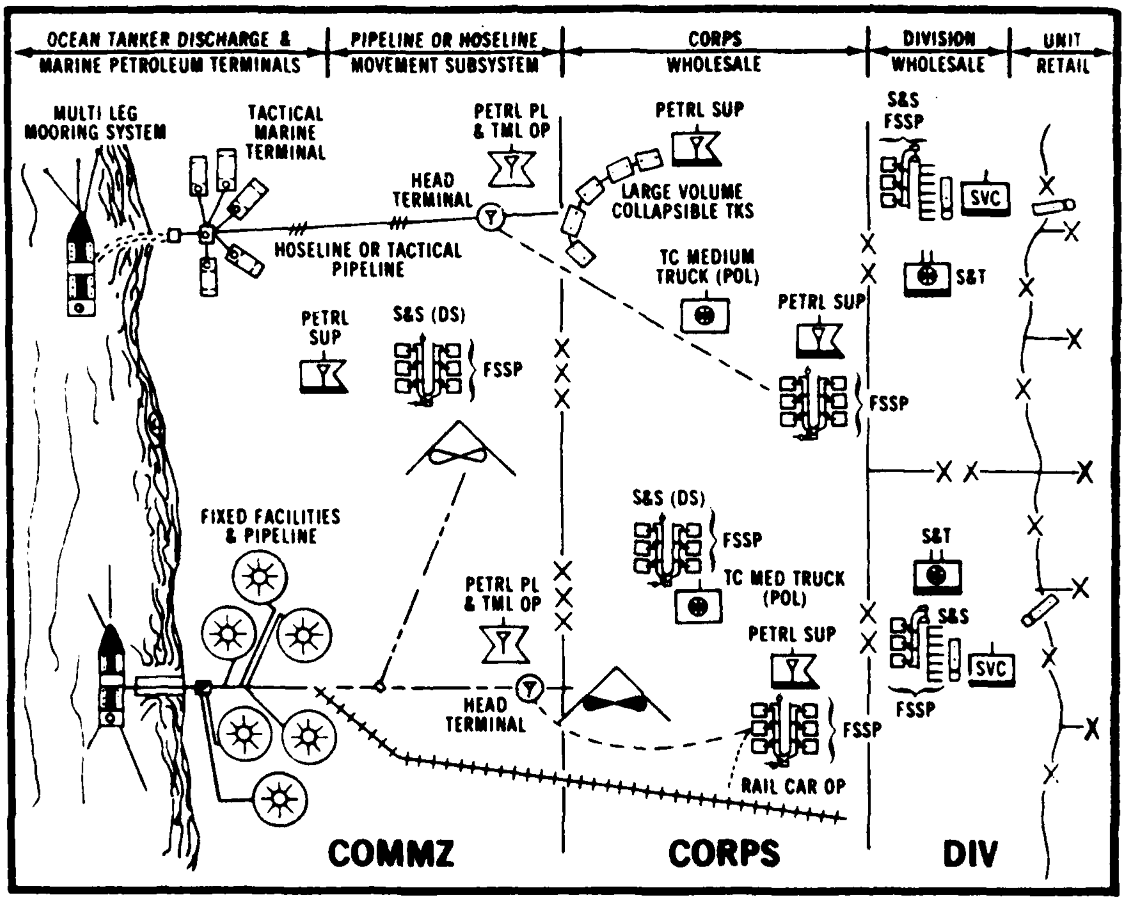

Figure B-10. Representative U.S. Army Bulk Petroleum Distribution System in Underdeveloped Theaters

supply and transport (S&T) battalions. When required a helicopter transportable forward area refueling equipment (FARE) system may be positioned in forward areas for refueling aircraft and ground vehicles. Fuel can be supplied to the FARE by helicopter lifted 500 gallon collapsible drums.

The components of this Army system basically mirror those provided in the current Marine Corps fuel storage and distribution system with relatively minor differences. Packaged fuel containers include 5-gallon cans, 55-gallon drums, and 500-gallon collapsible drums. Bulk petroleum containers include a 600-gallon skid-mounted metal tank used on cargo trucks and trailers or for above ground fuel storage, and 3,000-, 10,000- and 50,000-gallon collapsible fabric tanks. Fuel pumps and filters/separators range from 50- and 100- to 350- gpm capacity. An assault hoseline set consisting of 13,000 feet of 4-inch collapsible hose, a 350-gpm pumping assembly, plus related equipment is used as a temporary system to carry bulk petroleum to fuel systems supply points. The US Army FARE system consisting of a 100-gpm pumping assembly, a 100-gpm filter/separator, discharge and suction hoses, and refueling nozzles, when used with 500-gallon collapsible drums is essentially the same as Marine Corps expedient refueling system. The Army's M49A2C, 1,200-gallon tank truck and 5,000-gallon tank truck semi-trailers similarly parallel current Marine Corps capabilities.

6.2 US Air Force systems.

The US Air Force has systems for temporary storage of fuel at advanced or temporary airfields. Normally they do not transfer fuel in bulk except by airlift to isolated bases. Their principal forward area refueling unit is the AE32 R-14 Harvest Eagle system which incorporates a 600 gpm pump, filter/separator, distribution hose, and 50,000 gallon collapsible tanks. It is similar in concept and operation to the Marine Corps TAFDS system but lacks the flexibility of the TAFDS to be subdivided into smaller units to meet varied user requirements.

The delivery of bulk fuel by Air Force aircraft is accomplished primarily by the use of pillow tanks or 500-gallon collapsible drums. The basic system used for this mode of delivery is the aerial bulk fuel delivery system (ABFDS). This system, shown in figure B-11, is designed to be installed on the cargo handling system of the C-130 aircraft. It uses two 3,000 gallon aerial pillow tanks mounted on a modular platform to convert the aircraft to an aerial tanker with a 6,000-gallon capacity. In addition to the tanks it consists of a pallet and tiedown system, a tank armor system, two 600-gpm pumping assemblies, two bidirectional flow meters, suction and delivery hose, and auxiliary equipment and parts. An outside pumping source may be used to fill the tanks. A system manifold permits both tanks to be emptied with only one pumping module. For offloading, the system can be connected to any item of equipment that can be coupled to a 4-inch line, such as a fuel system supply point, tank refueler vehicle, or an assault hoseline. When the ABFDS is installed on a C-141 aircraft an additional aerial pillow tank can be added to the system bringing its capacity to 9,000 gallons.

Other representative capabilities of US Air Force aircraft to delivery bulk fuel can be illustrated using the C-5 transport. This aircraft can be

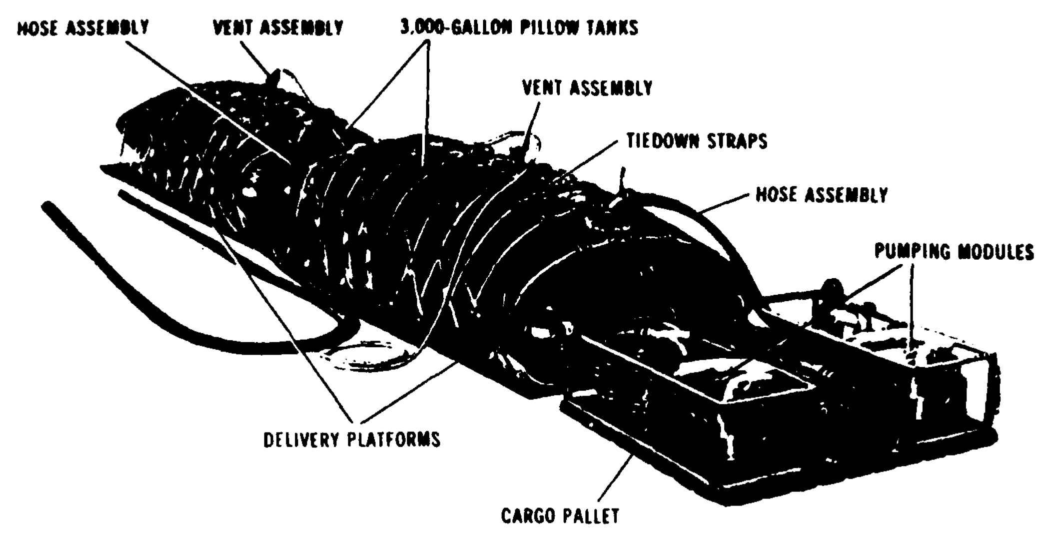

Figure B-11. Aerial Bulk Fuel Delivery System

configured with 6-3,600 gallon cabin tanks which in addition to integral wing fuel would provide approximately 70,000 gallons on board at the start of a mission. On a representative mission with a 1,000 mile radius, over 36,000 gallons of fuel would be available in this configuraton for offload at a mid-point forward airfield. When the C-5 is utilized to carry fuel in 500-gallon collapsible drums 62 drums (31,000 gallons) or 75 drums (37,500 gallons) could be transported at takeoff gross weights of 222,000 pounds and 265,000 pounds, respectively.

6.3 Commercial and other systems.

Commercial fuel pumps, filter/separators, hoses, rigid and collapsible tanks, and related equipment are available in a relatively wide range of capacities and configurations. These systems, as applicable to the storage and delivery of fuel for combat units, however, essentially duplicate in principal the types of equipment now used by the Marine Corps and the other military services. Additionally, related commercial developments and proposals are continuously monitored by the services as sources for current system product improvement or new concepts.

The principal new system concepts not currently used extensively for Marine Corps combat applications are electrically driven fuel distribution pumps, fabric pillow tanks specifically configured for aircraft or armored vehicles, and dual tandem semi-trailer tankers. Electrically driven pumps are currently being examined by the Marine Corps for possible use on cargo vehicles when such vehicles are carrying sixcon fuel modules and used in a refueler mode.

The Air Logistics Corporation aerial delivery sling tanks ranging in package sizes of 1,175/2,000 gallons are representative of this latter concept. Such pillow-type tanks have been mounted internally in helicopters, in the same manner as the Air Force ABFDS, to provide an aerial bulk fuel and off-ramp fueling capability, as well as carried externally by helicopters to supply isolated users. They also can be used as a fuel storage/supply tank when mounted in the cabin compartment of armored vehicles. Figures B-12 and B-13 illustrate these pillow tank applications. Dual tandem semi-trailer tankers (5,000 gallons each) have been available commercially for about five years. However, in their current design they have no off-road capability.

7. ALTERNATIVE FUEL SYSTEMS AND THEIR EVALUATION

7.1 Current and planned capabilities.

A recapitulation of the optimum utilization of current and planned fuel system capabilities to meet the four MCATF cases selected for analysis is shown in table B-20. System elements were selected on the basis of the best combination of the below listed factors in providing the MCATF-related fuel quantities required. (Note that primary distribution means are underlined in the figure.)

a. Minimum logistic burden to MCATF, particularly to maneuver elements.

b. Minimum fuel transfer and handling operations in providing fuel to ultimate user.

c. Minimum number of different types of fuel-related equipments in total fuel storage and distribution system.

d. Minimum combat vehicle "out of action" time for refueling process.

e. Ability to directly service the user as required by maneuver warfare environmet.

f. Minimum CH-53E helicopter daily support requirement.

7.2 Fuel system alternative A.

Alternative A consists of those current and planned fuel system equipments derived from table B-20. They include:

a. AAFS.

b. Additional AAFS 20,000 gallon pillow tanks for increased storage capability to meet increase in requirements introduced by the MCATF.

c. M970 semi-trailer tankers and prime movers for resupply link to MCATF-supporting CSSA.

Figure B-12. Bulk Fuel Delivery by Pillow-Type Sling Tank

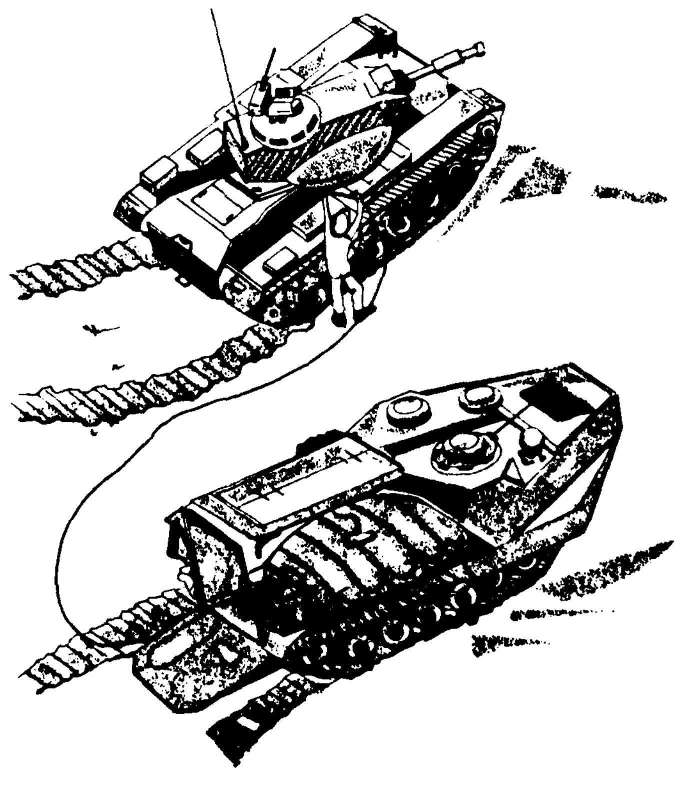

Figure B-13. Armored Vehicle Use of Pillow-Type Fuel Tank

Table B-20. Current/Planned Capabilities to Meet Case Requirements[1/]

MCATF Cases	Source	Dist'n	Canton-ment/BSA (Storage)	Dist'n	CSSA/MCSSD (Storage)	Dist'n	MCATF Trains (Storage)	Dist'n	MCATF Veh/AAH (Storage)
Case 1 (MCATF-4ME, AAH Sqdn)	X Amphib Ship Tanks					X Ship-board dispensing, Sixcon, 500-gal CD, Helo	X Sixcon, Dragon Wagon, HERS	X Dragon Wagon, Sixcon, Sixcon module pump, HERS	Veh tanks, AAH tanks, 5 gal cans
Case 2 (MCATF-4ME, AAH Sqdn, CSSA with V/STOL facility)	X Amphib Ship Tanks, Tanker Ships, Cargo A/C	X AAFS	X AAFS, TAFDS	X M970 Tanker, U.S. Army or host country pipeline	X(CSSA) TAFDS	X Sixcon, 500 gal CD, Helo, Dragon Wagon	X Sixcon, Dragon Wagon, HERS	X Dragon Wagon, Sixcon, Sixcon module pump, HERS	X Veh tanks, AAH tanks, 5 gal cans
Case 3 (MCATF-TF'A', AAH Sqdn, MCSSD)	X Amphib Ship Tanks, Tanker Ships, Cargo A/C	X AAFS	X AAFS, TAFDS	Sixcon, Helo, Dragon Wagon	X(MCSSD) Sixcon, Dragon Wagon	X Sixcon 500 gal CD, Helo, Dragon Wagon	X Sixcon Dragon Wagon, HERS	X Dragon Wagon, Sixcon, Sixcon module pump, HERS	X Veh tanks, AAH tanks, 5 gal cans
Case 4 (LAA Bn)							X 500 gal CD, LAV(L)	X LAV(L), 500 gal CD, HERS Pump	X Veh tanks, 5 gal cans

Legend: Sixcon --Field logistic system (FLS) fuel module. Six fastened with ISO fittings form 8 ft x 8 ft x 20 ft standard container.

AAFS--Amphibious assault fuel system.

TAFDS--Tactical airfield fuel dispensing system.

500 gal CD--500 gallon collapsible drum.

HERS--Helicopter expedient refueling system.

Helo--Transport helicopter, primarily CH-53E.

LAV(L)--Logistic light armored vehicle.

M970--5,000 gallon semi-trailer tanker.

Note: Primary distribution methods are underlined.

d. TAFDS.

e. Sixcon fuel module.

f. Sixcon pump module.

g. HERS (with diesel pump replacing present gasoline pump).

h. Additional HERS 500-gallon collapsible drums (CDs) for configuration of LAV(L) vehicles as tankers.

i. Additional HERS pump assemblies for configuration of LAV(L) vehicles as tankers.

j. 5-gallon cans.

Transportation means which interface with alternative A fuel system equipments are the transport helicopter (primarily the CH-53E), the dragon wagon, and the logistic light armored vehicle (LAV(L)).

7.3 Fuel system alternative B.

Alternative B consists of those fuel system equipments in alternative A with replacements where "off-the-shelf" commercial equipment or equipment currently used by the other armed services is superior. As addressed in paragraph five above, the capabilities of the other services and industry were evaluated. The only equipment evolving from that evaluation offering significant potential for system improvement is considered to be the vehicle mounted electric pump that can be mounted beneath the bed of the dragon wagon and on the chassis of LAV(L). It would draw power from the vehicle electrical system. Dragon wagons being utilized as tankers would then be capable of carrying one more sixcon fuel module in place of a sixcon pump module. The LAV logistics variant would similarly be relieved from reserving portions of its limited cargo space for pump storage. These applications of an electrically driven fuel pump would not eliminate the need for sixcon pump modules but would limit their primary usage to expedient rather than vehicular tanker-type applications. The use of fabric pillow tanks specifically configured for use either by aircraft or armored vehicles would be undesirable. Not only would their use introduce a new/specialized item into the system but their characteristics present significant disadvantages. When used as storage tanks in a vehicle's or aircraft's cargo compartment they would essentially dedicate that transporting means to use as a fuel carrier. Whereas, the use of standard 500-gallon collapsible drums for such purposes would allow rapid reconfiguration for other mission demands as needed. The potential advantage of a specialized pillow tank configured to optimize a vehicle's cargo space and payload would not offset the flexibility gained from using standard fuel modules. Relative to aircraft usage, carrying specialized pillow tank blatters internally would be unacceptable for the same safety reasons discussed earlier for 500-gallon collapsible drums. When employed as a container for externally carrying large fuel volumes by helicopter, pillow tanks would appear to offer a saving in tare weight relative to the sixcon fuel module. However, in practice it would present a high-drag, unstable load profile; be relatively fragile and subject to leakage under extended usage; and be essentially immobile when landed in

the forward combat areas. When this method of transporting fuel is required by blatters, the currently standard 500-gallon collapsible drums can be used with greater flexibility at equivalent or better tare weight savings.

Alternative B then consists of the following fuel system equipments:

a. AAFS.

b. Additional AAFS 20,000 gallon pillow tanks for increased storage capacity.

c. M970 semi-trailers and prime movers.

d. TAFDS.

e. Sixcon fuel module.

f. Sixcon pump module.

g. Vehicle mounted electric pumps on dragon wagons and LAV(L)s.

h. HERS (with diesel vice gasoline pump).

i. Additional HERS 500-gallon CDs.

j. 5-gallon cans.

7.4 *Fuel system alternative C*.

Alternative C consists of those equipments in alternative B with replacements where new conceptual equipments offer the most potential for improving system effectiveness. The application of improved technology toward product improvement in 500-gallon CDs, sixcon fuel modules, flexible hose pipeline/pumping stations, contamination inspection stations, and tanker semi-trailers offer the greatest potential. No major changes are foreseen however in the AAFS, TAFDS, HERS, and sixcon concepts. They are fundamentally sound.

The expeditionary nature and paucity of real estate in potential Marine Corps scenario areas point toward the current 20,000 gallon AAFS/TAFDS pillow tank being the optimum size. Improvement in the impregnated materials and the bonding techniques utilized is needed, however, to increase reliability, availability, and durability of the 20,000 gallon pillow tanks.

The original design goal of the sixcon fuel module is more applicable today than when it was conceived in 1972 as a 1,200 gallon tank deliverable in a lightweight, ISO compatible frame. Although the collapsible frame with impregnated fabric bag has been discarded as unreliable, a rigid lightweight metal sixcon module, with a capacity greater than the current 900 gallons, appears to be technologically feasible. The current tare weight of the sixcon fuel module of 2,500 pounds, as opposed to its payload, when considering that its primary delivery means is by helicopter, offers the greatest opportunity for improvement. Tare weight should come down and capacity go up.

Increased tanker capacity over that currently available (5,000 gallons) in the M970 semi-trailer is desired in order to reduce the size of the tanker fleet required to support inland CSSAs. Tandem fuel trailers are now commercially available but not in designs suitable to the limited off-road capability desired by the Marine Corps. Conceptually, however, tandem-type tanker trailers of 5,000 gallons each, towable in pairs with limited off-road capability, are certainly feasible and are highly desirable.

The Marine Corps commitment to the RDJTF has introduced a pipeline tie-in requirement not normally envisioned as applicable in conventional amphibious operations. Product improved hose sections (i.e., more flexible, more durable) and greater booster pump capability (to reduce the number of booster stations required for pipeline tie-in) are desired.

The requirement for increased bulk fuel storage capacity contributes to a need for increased capability in contamination monitoring. Purging contaminated fuel, in the size system now envisioned, will be a major problem and must be kept to an absolute minimum.

Alternative C then consists of the following fuel system equipments:

a. AAFS with product improved pillow tanks and decontamination monitoring capability.

b. Additional product improved AAFS 20,000 gallon pillow tanks for additional storage.

c. Product improved AAFS hose, pumping stations, and decontamination monitoring capability required for the establishment of forward CSSAs and tie-in with U.S. Army or host country provided pipelines (RDJTF environment).

d. TAFDS with product improved pillow tanks and decontamination monitoring capability.

e. 5,000 gallon semi-trailer tankers capable of tandem tow under limited off-road conditions.

f. Product improved SIXCON fuel modules.

g. Sixcon pump module.

h. Vehicle mounted electric pumps on dragon wagons and LAV(L)s.

i. HERS (with diesel vice gasoline pumps).

j. Additional HERS 500-gallon CDs.

k. 5-gallon cans.

8. STUDY FINDINGS

8.1 Validation of sixcon fuel module concept.

The study group view from the onset was that the MCATF (and maneuver warfare) posed a significant challenge to the utility of the sixcon fuel module. This challenge was supported by the following factors:

a. A large increase in fuel consumption.

b. A shift in wholesale distribution emphasis from "primary truck, secondary helicopter" to "primary helicopter, secondary truck."

c. Failure to meet the original design goals of the sixcon fuel module, i.e., a collapsible, lightweight frame with an impregnated fabric tank of 1,200 gallon capacity.

d. The comparative ratio of 285 pounds of empty weight divided by a 3,500 pound payload weight (0.0814) for the 500 gallon collapsible drum versus the ratio of 2,500 pounds of empty weight divided by a 6,300 pound payload weight (0.3968) for the sixcon fuel module--an increase of 387 percent.

It appeared from a suboptimized perspective that the 500-gallon collapsible drum, already in the field and of proven reliability, was the best solution. However, it was not the best solution when the problem of MCATF fuel support was analyzed from a total system approach. As presented in section five of this annex, under the constraints of a 75 NM operating radius and external/internal loading restrictions, the advantage of the 500-gallon collapsible drum, expressed in terms of dedicated CH-53E helicopter support requirements, dropped astronomically to approximately 15 percent. This apparent disadvantage for the sixcon fuel module is further mitigated by its compatibility/commonality with all transportation and storage mediums, i.e., by its inherent system-related modularity. The modular design of the sixcon fuel module also contributes to ease in handling and transfer which, even with its additional weight and cube, minimizes the logistic burden of the MCATF.

There is uncertainty associated with any concept or plan, and the uncertainty associated with attainment by the Marine Corps of the capability to fully support the MCATF unit trains by helicopter is judged to be relatively high. The shift to primary support of the MCATF by helicopter is, however, assessed to be relatively certain, although the phasing from "primary truck" to "primary helicopter" is expected to be gradual over the next 15 years, depending on CH-53E procurement and production. It, therefore, appears prudent that development agencies should adopt a strategy that fits this evolutionary process. The continuation of development in accordance with the sixcon concept is supported by this view, particularly since there is a paucity of technological breakthroughs that point toward innovative new concepts.

In summary, continuation of sixcon fuel module development has the greatest potential for producing optimum MCATF fuel support with the least risk.

8.2 Validation of AAFS, TAFDS, and HERS.

There were two challenges to AAFS and TAFDS that arose during the course of the study, as posed in the following questions.

a. Did the types of Marine Corps MCATF operations envisioned in the Marine Corps Long Range Plan (i.e., amphibious operations from a seabase and RDJTF operations from a benign cantonment) eliminate the requirement for a BSA and the related AAFS and TAFDS?

b. Did MCATF operating concepts point toward replacing the static bulk fuel storage of AAFS and TAFDS with large, mobile bulk fuel facilities that operate and move with the MCATF?

The answer to both questions is no. As addressed more fully in the basic report (volume I), AAFS and TAFDS are required in the RDJTF environment. Although some host country support and other U.S. service support may evolve, it can not be relied upon to the exclusion of the traditional Navy/Marine Corps bulk fuel systems. To the contrary, having AAFS and TAFDS prepackaged expeditionary bulk fuel systems, with their adaptability to the establishment of either remote littoral or inland CSSAs, could be the deciding factor in the commitment of Marine Corps forces rather than other U.S. armed forces in an RDJTF operation. Furthermore, although amphibious operations from a seabase during the long-range period would not normally include a BSA, the requirement to maintain the capability to operate that facility still exists, as does the requirement to establish CSSAs (with AAFS and/or TAFDS) to support non-MCATF configured Marine ground and air forces.

Having a large MCSSD that supports more than one regimental size MCATF with more than one day of supply is viewed as an infeasible CSS concept in the basic report (volume I). Such large MCSSDs, as demonstrated in the recent 29 Palms, California MCATF field exercises, excessively restrict the capability of the MCATF to maneuver and provide a soft "underbelly" that invites enemy attack. The basic MCATF CSS study demonstrates that an MCSSD is practical only when large MCATF forces are fielded (i.e., to provide adequate security for the MCSSD) and then only with one day of supply (to keep the size manageable). It was shown that bulk fuel, in quantity, is best stored remote from the MCATF in a secure area such as a CSSA, cantonment, or aboard ship, and delivered to the MCATF trains as required. This supports the continued utilization of AAFS and TAFDS (and HERS).

8.3 Long range development plan.

The recommended equipments for the fuel storage and distribution system considered to be the long range development goal are contained in alternative C, paragraph 7.4 of this annex. The essential elements are:

a. Product improvement of the sixcon fuel module to increase capacity and reduce empty weight.

b. Product improvement of the fabric pillow tanks of TAFDS and AAFS to increase reliability and durability.

c. Product improvement of contamination monitoring equipment to increase sensing capability and reliability.

d. Product improvement of pumping stations and associated pipeline hose to improve capability for tie-in with U.S. Army or host country provided pipelines.

e. Continuation of monitoring of commercial and other service fuel related projects/equipments to assure "off-the-shelf," state of the art currency (i.e., pursuit of the vehicle mounted electric pump to partially replace the sixcon fuel module and the tandem-type semi-trailer tanker to give greater capacity than the M970).

APPENDIX 1 to ANNEX B

TABLE OF ACRONYMS AND ABBREVIATIONS

AA BN DET	Assault Amphibian Battalion Detachment
AAH	Advanced Attack Helicopter
AAFS	Amphibious Assault Fuel System
ABFDS	Aerial Bulk Fuel Distribution System (Air Force)
ADW	Armored Dragon Wagon
ANSI/ISO	American National Standards Institute/International Standardization Organization
AOA	Amphibious Objective Area
ARTY BTRY 155(SP)	Artillery Battery 155mm Self-Propelled
ARTY FO TM	Artillery Forward Observer Team
ATF/G	Amphibious Task Force or Group
AVLB	Armored Vehicle-Launched Bridge
BN AID	Battalion Aid Section (Medical)
BSA	Beach Support Area
CD	Collapsible Drum
CH-53E	Heavy Lift Helicopter
COMMZ	Communication Zone (Army)
CS	Combat Support
CSS	Combat Service Support
CSSA	Combat Service Support Area
DW	Dragon Wagon
ECP	Education Center Publication
ENGR SPT BN	Engineer Support Battalion
ESPAWS	Experimental Self-Propelled Artillery Weapon System, 155mm Howitzer
FAAD	Forward Area Air Defense
FARE	Forward Area Refueling Equipment
FEBA	Forward Edge of the Battle Area
FLS	Field Logistic System
FSSP	Fuel System Supply Point (Army)
GPD	Gallons Per Day
GPM	Gallons Per Minute
HERS	Helicopter Expedient Refueling System
HMTT	High Mobility Tactical Truck
H/S BN	Headquarters and Service Battalion
HST	Helicopter Support Team
JP-5	Jet Petroleum Number Five
LAAB	Light Armored Assault Battalion
LAA CO	Light Armored Assault Company

LAV	Light Armored Vehicle
LAV(AD)	Light Armored Vehicle, Air Defense
LAV(AG)	Light Armored Vehicle, Assault Gun
LAV(C)	Light Armored Vehicle, Command
LAV(L)	Light Armored Vehicle, Logistics
LAV(LA)	Light Armored Vehicle, Light Assault
LAV(M)	Light Armored Vehicle, Mortar
LAV(R)	Light Armored Vehicle, Recovery
LCAC	Landing Craft Air Cushion
LHA	Amphibious Assault Ship, General Purpose
LPD	Amphibious Transport Dock
LPH	Amphibious Assault Ship
LS CO	Landing Support Company
LSD	Landing Ship Dock
LST	Landing Ship Tank
LVTX	Landing Vehicle Tracked Experimental
LVTX-AG	Landing Vehicle Tracked Experimental, Assault Gun
LVTX-C	Landing Vehicle Tracked Experimental, Command
LVTX-E	Landing Vehicle Tracked Experimental, Engineer
LVTX-P	Landing Vehicle Tracked Experimental, Personnel
LVTX-R	Landing Vehicle Tracked Experimental, Recovery
MAD PLT	Mobile Air Defense Platoon
MAF	Marine Amphibious Force
MAGTF	Marine Air-Ground Task Force
MAG(VH)	Marine Air Group, Helicopter
MAINT BN	Maintenance Battalion
MARCORS-5	Marine Corps Scenario Number Five
MCAGCC	Marine Corps Air-Ground Combat Center
MCATF	Mechanized Combined Arms Task Force
MCATF AID	Mechanized Combined Arms Task Force, Medical Aid Team
MCATF-4ME	Mechanized Combined Arms Task Force, Four Maneuver Elements
MCESS	Marine Corps Expeditionary Shelter System
MCSSD	Mobile Combat Service Support Detachment
MCSSU	Mobile Combat Service Support Unit
ME	Maneuver Element
MED BN	Medical Battalion
MLRP	Marine Corps Long-Range Plan
MLRS	Multiple Launcher Rocket System
MRL BTRY HQ	Multiple Rocket Launcher Battery Headquarters
MSR	Main Supply Route
MT BN	Motor Transport Battalion
M-578	Medium Tracked Vehicle Retriever
M-88	Heavy Tracked Vehicle Retriever
NM	Nautical Mile
OH	Operational Handbook
PGRG	Potomac General Research Group
POL	Petroleum Oil and Lubricant

PSI	Pounds Per Square Inch
PTRL PL & TML	Petroleum Pipeline and Terminal (Army)
RDJTF	Rapid Deployment Joint Task Force
RECON	Reconnaissance
S&S CO	Supply and Service Company (Army)
S&T BN	Supply and Transport Battalion (Army)
SIXCON	Six Per Container. Field Logistic System Module (4'x 6 2/3' x 8')
SP	Self-Propelled
STINGER	Surface-to-Air Missile System
TAFDS	Tactical Airfield Fuel Dispensing System
TARE	Empty Weight
TARG ACQ DET	Target Acquisition Detachment
TF-ALPHA	Task Force Alpha
TOW	Tube-Launched, Optically Tracked, Wire Command, Link-Guided Missile
UT	Unit Train
V/STOL	Vertical/Short Field Takeoff and Landing
25mm	Bushmaster Rapid Fire 25mm Gun, Mounted on LVTX-P
81mm	81mm Mortar

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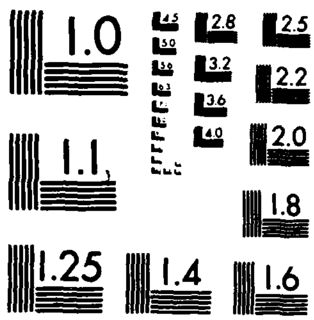

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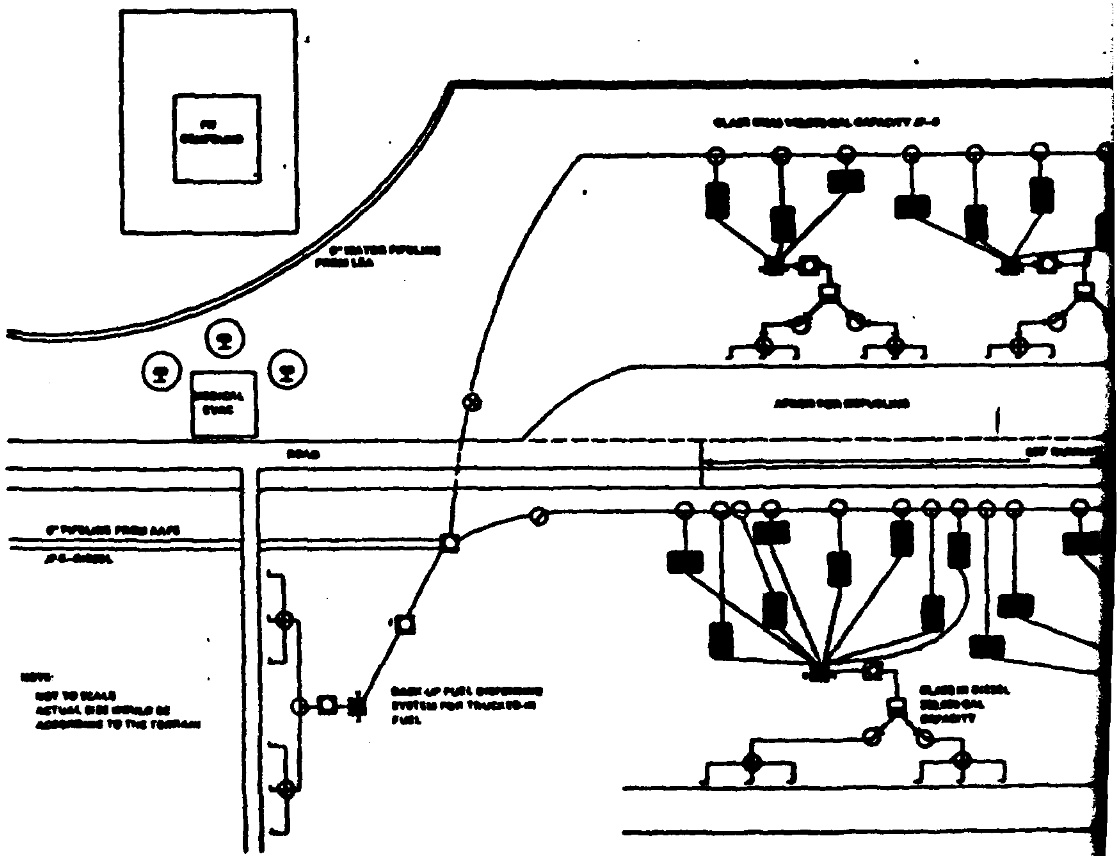
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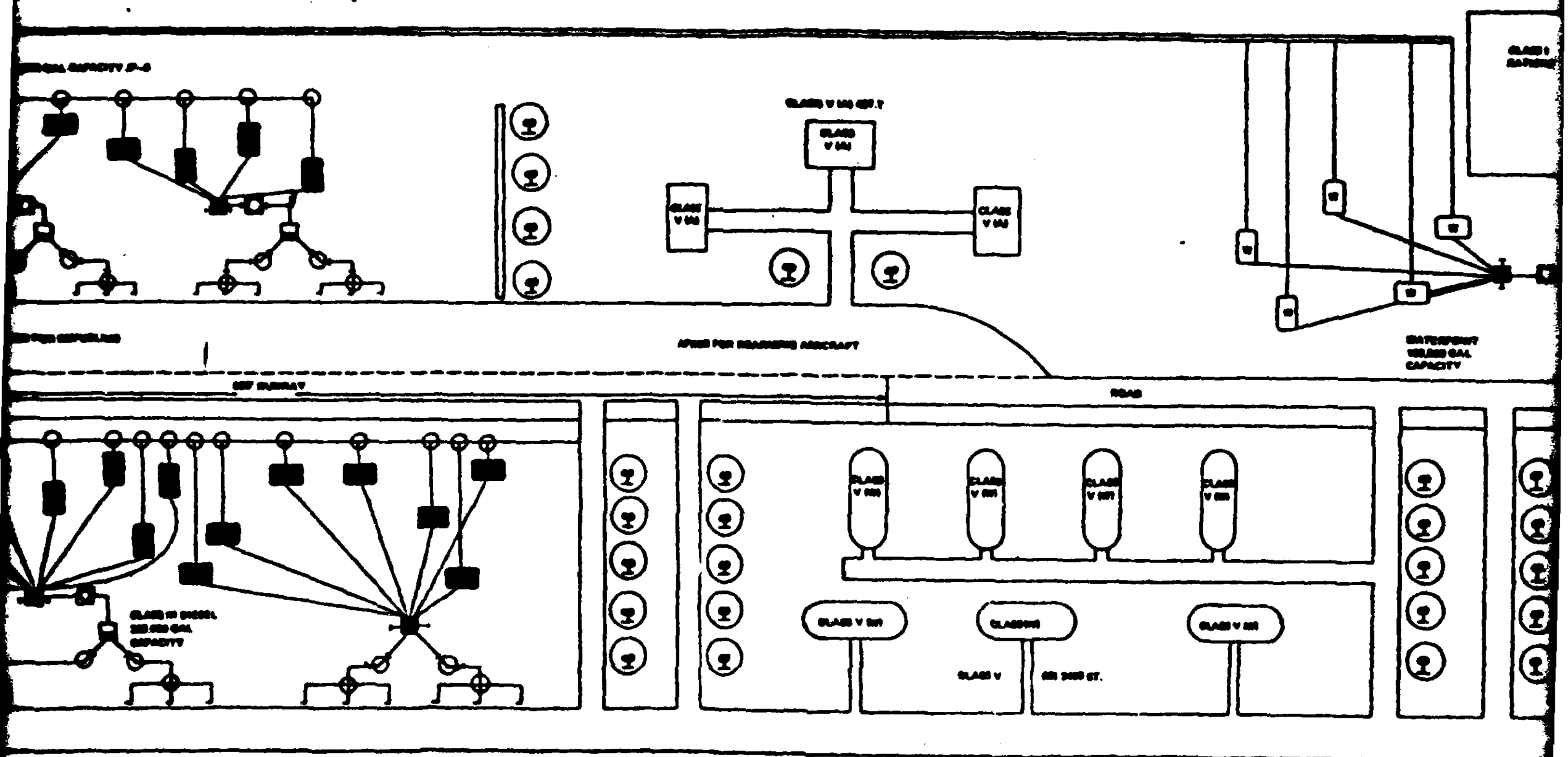

Figure I-9. Representative CSSA

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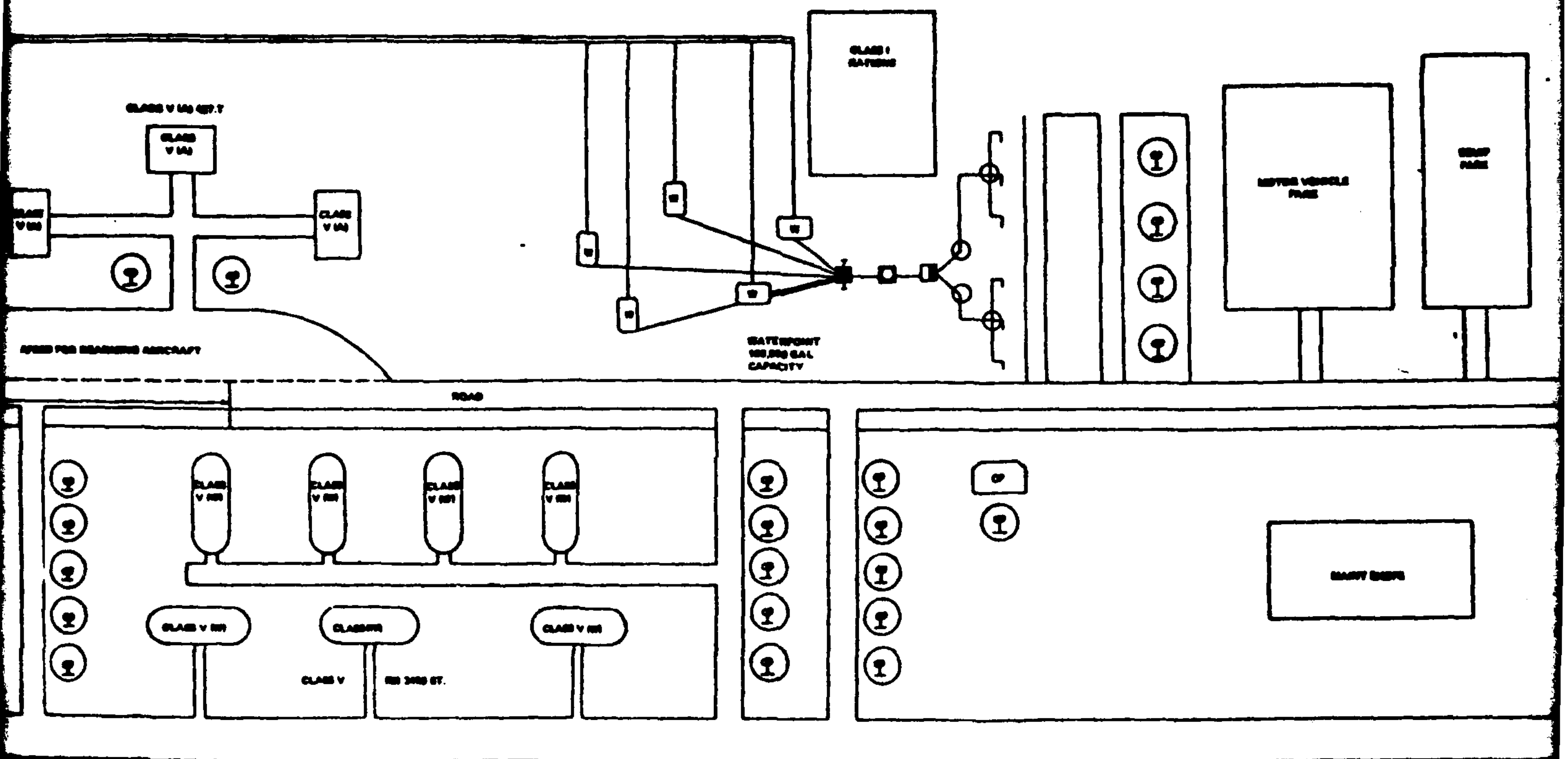

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